

REVISION OF THE GUAYANA HIGHLAND BROMELIACEAE¹

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ABSTRACT

Genera and species of Bromeliaceae that have been described from the Guayana Highland since *Flora Neotropica* treatments of the subfamilies Pitcairnioideae and Tillandsioideae by Smith and Downs in 1974 and 1977 are distinguished by amended or completely rewritten keys. Of the species, 26 are here described as new, 24 being Pitcairnioideae. *Lindmania* is resurrected from the synonymy of *Cottendorfia*, and an error in the validation of *Steyerbromelia* is corrected.

At the time of the monographs of the first two subfamilies of the Bromeliaceae in the *Flora Neotropica* (Smith & Downs, 1974, 1977), the area from which the most future additions were expected was the Guayana Highland. Recent collecting in the area has confirmed the suspicion. Among the new species added are 26 described in the present paper. In addition to the new species, mostly in the Pitcairnioideae, two Pitcairnioid genera, *Brewcaria* and *Steyerbromelia*, have been described (in Steyermark et al., 1984) since the *Flora Neotropica* monograph, and more recent studies have shown that Guayanian *Lindmania* must be resurrected from the synonymy of the genus *Cottendorfia* of eastern Brazil. The present paper, in addition to describing new species, summarizes by use of keys the distinctions of all species and genera described

from the area since the monograph. Also, an error in the validation of *Steyerbromelia* is corrected.

The area covered in the present paper is the same as in the Bromeliaceae of the Guayana Highland (Smith, 1967), which should be referred to for a more complete presentation of the family in the area, especially in the subfamilies Tillandsioideae and Bromelioideae. The numbers preceding the species and genera follow those in the *Flora Neotropica*. New entries are given a decimal number under the number of the genus or species with which they would appear in the keys of the *Flora*. In view of the many additions, keys are provided to all known species of the Pitcairnioid genera, *Connellia*, *Lindmania*, *Steyerbromelia*, *Brocchinia*, and *Brewcaria*, and amended keys are provided for many parts of *Navia*.

PITCAIRNIOIDEAE

KEY TO GENERA

- 1a. Seeds appendaged.
 - 2a. Petal-blades tightly spiraled after anthesis; ovary superior or slightly inferior. Andean plants of open slopes and summits from Costa Rica and Guyana to Chile and Argentina 1. *Puya*
 - 2b. Petal-blades remaining separate after anthesis.
 - 3a. Ovary wholly superior; ovules bicaudate; petals regular.
 - 4a. Sepals convolute with the left side of each overlapping the right of the next one; petals naked; inflorescence simple or compound. Guayana Highland.
 - 5a. Anthers subbasifixed; petals brightly colored, more or less massed together after anthesis but not twisted; sepals large and firm 4. *Connellia* (p. 690)
 - 5b. Anthers equitant; petals white or rose, separate after anthesis; sepals not over 10 mm long, thin at least marginally 5. *Lindmania* (p. 690)
 - 4b. Sepals imbricate; petals appendaged with 2 vertically attached scales; inflorescence compound 5a. *Steyerbromelia* (p. 699)
 - 3b. Ovary partially to wholly inferior.
 - 6a. Sepals convolute with the left side of each overlapping the right of the next one; petals large, usually zygomorphic and forming a hood over the anthers. Mexico and the West Indies to Argentina and Brazil 8. *Pitcairnia* (p. 700)

¹ In this paper the new species are coauthored by Julian Steyermark, who collected and made initial observations of most of the specimens, and in the Pitcairnioideae by Harold Robinson who provided the anatomical observations. Careful editing of the manuscript by Robert Read is greatly appreciated.

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- 6b. Sepals imbricate with both posterior ones overlapping the anterior; petals small, regular. Guayana Highland.
- 7a. Epigynous tube lacking; inflorescence open and definitely branched 9. *Brocchinia* (p. 702)
- 7b. Epigynous tube well developed; inflorescence sessile, capitate 10. *Ayensua*
- 1b. Seeds naked or with a very narrow circumferential wing; sepals imbricate. Guayana Highland.
- 8a. Petals naked; inflorescence usually compound or densely capitate 11. *Navia* (p. 703)
- 8b. Petals appendaged with 2 horizontally attached scales; inflorescence simple, densely cylindrical 11a. *Brewcaria* (p. 714)

4. **CONNELLIA** N. E. Brown, Trans. Linn. Soc. II. 6: 66, pl. 13. 1901.

- 1a. Inflorescence compound although the short branches often covered by ample primary bracts at anthesis.
- 2a. Sepals ecarinate, 12 mm long; branches not elongating in fruit. Roraima 2. *C. augustae*
- 2b. Sepals sharply carinate, 14–21 mm long; branches greatly elongating in fruit.
- 3a. Leaf-blades concolorous, serrate at base; inflorescence glabrous; sepals elliptic, obtuse, 14 mm long. Ptari-tepui, Cerro Venamo 1. *C. nutans*
- 3b. Leaf-blades narrowly pale-margined, serrulate throughout; inflorescence villose or villosulous; sepals lanceolate, acuminate, 21 mm long. Auyan-tepui 1.1. *C. varadarajanii*
- 1b. Inflorescence simple.
- 4a. Leaf-blades densely tomentose-lepidote above and on the margins. Roraima 3. *C. quelchii*
- 4b. Leaf-blades glabrous above, green with prominent white margins. Ilu-tepui, Gran Sabana 4. *C. caricifolia*

1.1. *Connellia varadarajanii* L. B. Smith & Steyermark, Journ. Bromel. Soc. 35: 52, fig. 2. 1985 (fig. 1 was actually *C. smithiana* Steyermark & Luteyn).

The leaf anatomy of the recently described species has been examined to allow comparison with other members of the genus. The vascular bundles are recessed in chlorenchyma adaxially but exposed to water storage tissue, they are narrowly covered by chlorenchyma abaxially; water storage cells 3–4-stratose adaxially, ca. 3-stratose in distinct canals abaxially; subepidermal cells with one subdistinct layer adaxially with outer walls slightly thickened, with one distinct moderately thickened layer abaxially; substomatal pore not occluded, oval or rounded; abaxial surface with minute subpeltate or shortly strap-shaped scales, cells transversely oblong.

The leaf cross-section shows the pattern of some water storage tissue and a narrow layer of chlorenchyma abaxial to the vascular bundles similar

to the pattern in the four species of *Connellia* known at the time of the anatomical study of Robinson (1969). Of the four, only *C. quelchii* has larger bundles lacking abaxial chlorenchyma. None of the other species has as much abaxial water storage tissue, but *C. nutans* seems closest in this regard. *Connellia nutans* and *C. augustae* do not have the vascular bundles recessed in the chlorenchyma adaxially as in the new species, *C. quelchii*, and *C. caricifolia*.

The general form of the leaf cross-section is the type seen again in such species of *Lindmania* as *L. brachyphylla*, *L. tillandsioides*, *L. riparia* and *L. sessilis*, and the genus *Connellia* may relate to that element of *Lindmania*.

The general type of leaf cross-section seen in *Connellia* is not found in the recently described *C. smithiana* in which the larger vascular bundles all have fiber sheaths continuous with the abaxial epidermis. This reenforces other evidence that *C. smithiana* should be transferred from *Connellia* to *Lindmania*. The abaxially buttressed bundles are similar to those seen in *Lindmania minor*, *L. thyrsoides*, and the newly described *L. huberi* and *L. imitans*.

2. *Connellia augustae* N. E. Brown is endemic to Roraima. Other citations in Fl. Neotrop. no. 14(1): 211, 1974, are *C. nutans* L. B. Smith.

5.2. **LINDMANIA** Mez, DC. Monogr. Phan. 9: 535. 1896.

The resurrection of the Guayanian *Lindmania* comes as a result of further study that puts greater emphasis on the aestivation or overlapping of the sepals. There have been two previous indications of generic difference noted between *Lindmania* and the Bahian *Cottendorfia* to which I had reduced it (Smith & Downs, 1974: 212). Robinson (1969: 8) pointed out significant differences in the cell walls of the abaxial epidermis and in the stomata. Recently I verified by specimens the unisexual nature of the flowers in *Cot-*

tendorfia. Mez (1894, pl. 93) had illustrated it as unisexual although he described the genus as having "Flores hermaphroditi" (p. 502). Finally, I now find that the sepals of *Lindmania* are convolute with the left side of each overlapping the right of the next one while those of *Cottendorfia* are cochlear with the anterior sepal overlapping the two posterior ones.

The following key, although still largely artificial, eliminates weak points in that of the *Flora Neotropica* but keeps its enumeration. Robinson's findings are included and in some cases show correlation with the macroscopic characters.

- 1a. Inflorescence simple or subsimple.
- 2a. Scape very short or lacking; inflorescence dense, hidden in the leaves. Chimantá.
- 3a. Leaf-blades straight; sepals broadly lanceolate, 9 mm long 24. *L. navioides*
- 3b. Leaf-blades strongly recurved; sepals suborbicular, 4 mm long 24.1. *L. huberi*
- 2b. Scape evident; inflorescence lax or sublax.
- 4a. Flowers in fascicles; inflorescence otherwise very lax. Chimantá 20. *L. subsimplex*
- 4b. Flowers single.
- 5a. Scape-bracts much shorter than the internodes; scape slender (inflorescence normally bipinnate). Northwestern Guyana and adjacent Venezuela 15. *L. guianensis*
- 5b. Scape-bracts exceeding the internodes.
- 6a. Plant arachnoid-vestite; scape relatively stout, 4 mm thick, to 36 cm long. Marahuaca 20.1. *L. arachnoidea*
- 6b. Plant obscurely lepidote; scape 1.5 mm thick, to 10 cm long. Chimantá.
- 7a. Scape-bracts very narrow, completely exposing the scape; leaf-blades 5 mm wide 20.2. *L. aurea*
- 7b. Scape-bracts ample, densely imbricate; leaf-blades 10 mm wide 20.3. *L. imitans*
- 1b. Inflorescence bipinnate or rarely subtripinnate or subsimple with a distinct basal branch.
- 8a. Primary bracts equaling or exceeding the sterile bases of at least the lower branches.
- 9a. Floral bracts about equaling to exceeding the pedicels.
- 10a. Pedicels 8 mm long; inflorescence tomentose-lepidote. Neblina 16. *L. maguirei*
- 10b. Pedicels not more than 3.5 mm long or lacking.
- 11a. Branches 1.5–4 cm long, inflorescence narrowly cylindrical, at least at apex.
- 12a. Floral bracts narrowly triangular; leaf-blades entire, much exceeding the inflorescence; 1 cm wide. Chimantá 22. *L. stenophylla*
- 12b. Floral bracts lanceolate to broadly elliptic; leaf blades toothed near the base or not much exceeding the inflorescence.
- 13a. Inflorescence dense only near apex; scape-bracts shorter than the upper internodes; leaf blades entire, ca. 1 cm wide. Abácapa-tepui 19. *L. tillandsioides*
- 13b. Inflorescence dense throughout; scape-bracts densely imbricate; leaf blades minutely toothed basally, 35 mm wide. Auyan-tepui 19.1. *L. riparia*
- 11b. Branches more than 4 cm long, divergent; inflorescence lax or sublax.
- 14a. Flowers 3–3.5 mm pedicellate.
- 15a. Inflorescence subdensely vestite with microscopic glanduliform ferruginous scales; primary bracts entire; leaf-blades serrulate only at base. Cerro Parú 11. *L. phelpsiae*
- 15b. Inflorescence flocculose with fine linear white scales; primary bracts serrulate; leaf-blades serrulate throughout. Apacará-tepui, Chimantá 2. *L. serrulata*
- 14b. Flowers sessile. Chimantá.
- 16a. Leaf-blades serrulate, 35 mm wide; plant flowering over 7 dm high 2.1. *L. sessilis*
- 16b. Leaf-blades entire, 12 mm wide; plant flowering 46 cm high 2.2. *L. saxicola*
- 9b. Floral bracts distinctly shorter than the pedicels.
- 17a. Sterile base longer than the fertile part of branch, about equaling primary bract. Auyan-tepui 13. *L. longipes*
- 17b. Sterile base shorter than fertile part of branch, much shorter than the basal primary bracts.
- 18a. Inflorescence lateral in leaf-axils, subtripinnate. Neblina 4.1. *L. lateralis*
- 18b. Inflorescences terminal; primary bracts equaling or shorter than the branches.
- 19a. Branches short; inflorescence densely cylindrical.

- 20a. Primary bracts very narrow, wholly exposing the branches; inflorescence erect. Serrania Yutaje 21. *L. thyrsoides*
- 20b. Primary bracts broad, covering most of each branch; inflorescence prostrate. Auyan-tepui 21.1. *L. smithiana*
- 19b. Branches elongate; inflorescence lax at least at base.
- 21a. Pedicels subfiliform, spreading, about as long as the flowers.
- 22a. Inflorescence glabrous; pedicels 10–15 mm long; leaf-blades laxly serrate throughout. Duida, Abacapá-tepui, Marahuaca 4. *L. wurdackii*
- 22b. Inflorescence vestite; pedicels 3.5–7 mm long.
- 23a. Pedicels 3.5 mm long; inflorescence vestite with pale narrow spreading scales. Cerro Venamo, Gran Savanna 3. *L. gracillima*
- 23b. Pedicels 7 mm long; inflorescence tomentulose-lepidote, verruculose. Neblina 12. *L. dendritica*
- 21b. Pedicels cylindrical or obconic, longer than the flowers.
- 24a. Leaf-blades densely flocculose beneath, obscurely denticulate throughout; inflorescence flocculose. Chimantá 23. *L. minor*
- 24b. Leaf-blades glabrescent, serrulate at base.
- 25a. Inflorescence vestite; scape and primary bracts with distinct ovate base and long very narrow blade. Serra Aracá 23.1. *L. piresii*
- 25b. Inflorescence glabrous; scape and primary bracts narrowly triangular with little distinction between base and blade. Marahuaca.
- 26a. Leaf-blades verruculose; flowering shoot obviously very tall (ca. 2 m estimate) and straight 23.2. *L. terramarae*
- 26b. Leaf-blades smooth except for nerves; flowering shoot to 1 m tall and decurving 23.3. *L. marahuacae*
- 8b. Primary bracts all shorter than the sterile bases of the branches.
- 27a. Floral bracts exceeding the pedicels.
- 28a. Leaf-blades linear-lanceolate with slightly convex sides, 33 mm wide, plane or narrowly revolute. Sarven-tepui, Auyan-tepui 17. *L. brachyphylla*
- 28b. Leaf-blades narrowly triangular with straight sides, 15 mm wide, strongly involute. Chimantá 18. *L. steyermarkii*
- 27b. Floral bracts about equaling or shorter than the pedicels.
- 29a. Scape-bracts much shorter than all but the lowest internodes.
- 30a. Leaf-blades serrulate toward base; margins recurved; axis 5 mm thick; racemes dense. Western Venezuela and adjacent Guyana and Brazil 14. *L. geniculata*
- 30b. Leaf-blades entire; margins incurved; axis 2.5 mm thick; racemes lax. Roraima, Kaieteur Plateau, Gran Savanna 15. *L. guianensis*
- 29b. Scape-bracts exceeding all or all but the highest internodes.
- 31a. Indument on the upper side of the leaf-blade; inflorescence glabrous; leaf-margins recurved. Central Guayana Highland 5. *L. paludosa*
- 31b. Indument mostly or wholly on the underside of the leaf-blade; inflorescence glabrous or vestite.
- 32a. Racemes lax; leaf-blades 15 mm wide. Central Guayana Highland 10. *L. argentea*
- 32b. Racemes dense or subdense; leaf blades 24–40 mm wide.
- 33a. Pedicels 5–12 mm long, much exceeding the floral bracts; leaf-margins recurved.
- 34a. Sepals retuse, verruculose; leaf-blades 40 mm wide, their indument persistent; pedicels 5 mm long. Serrania Yutaje 6. *L. cylindrostachya*
- 34b. Sepals broadly elliptic, even; leaf-blades largely glabrescent, 25–35 mm wide.
- 35a. Branches curved ascending. Neblina 7. *L. savannensis*
- 35b. Branches straight, spreading. Cerro Guaiquinima 7.1. *L. atrorosea*
- 33b. Pedicels 1.5–3 mm long, about equaling the floral bracts.
- 36a. Sterile bases of the branches to 7 cm long, about twice the length of the primary bracts. Neblina 8. *L. nubigena*
- 36b. Sterile bases of the branches not over 2 cm long, only slightly exceeding the primary bracts. Auyan-tepui 9. *L. dyckioides*

2. *Lindmania serrulata* L. B. Smith, Contr. U.S. Nat. Herb. 29: 283, fig. 8. 1949. *Cottendorfia serrulata* (L. B. Smith) L. B. Smith, Phytologia 7: 170. 1960.

2b. *Lindmania serrulata* var. *reducta* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 414. 1957. *Cottendorfia serrulata* var. *reducta* (L. B. Smith) L. B. Smith, Phytologia 7: 170. 1960.

2.1. *Lindmania sessilis* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 1, 27a-d. TYPE: Venezuela. Bolívar: Distrito Piar, Macizo del Chimantá, Sector centro-noreste del Chimantá-tepui, cabeceras orientales del Caño Chimantá, ca. 2,000 m alt., Lat. 5°18'N, Long. 62°09'W, 26-29 Enero 1983, *Julian A. Steyermark, Otto Huber & Victor Carreño E. 128104* (holotype, US; isotype, VEN).

Planta e fragmentis perveteribus solum cognita, florifera ultra 7 dm alta. Folia 5 dm longa; vaginis brevibus amplis; laminis anguste triangularibus, 35 mm latis, omnino serrulatis, ad basim subtus dissite lepidotis.

Scapus rectus, ca. 15 mm diametro; scapi bracteis erectis, subfoliaceis, internodia multo superantibus. Inflorescentia laxa bipinnatim paniculata, setifera; bracteis primariis eis scapi similibus, ramorum basibus sterilibus brevissimis longioribus; ramis rectis, divergentibus, ad 11 cm longis, dense florigeris. Bracteae floriferae anguste triangulares, serrulatae, sepala superantes; floribus sessilibus. Sepala ovata, ca. 5 mm longa, base setifera. Capsula ovoidea; seminibus bicaudatis.

Leaf anatomy. Vascular bundles not or little recessed in chlorenchyma and exposed to water storage tissue adaxially, narrowly covered by chlorenchyma abaxially; water storage cells 3-4-stratose adaxially, in distinct canals with firm-walled cells abaxially, subepidermal cells adaxially and abaxially bistratose, smaller cells thickened on the exterior part of their walls; substomatal pores small, oval, with walls subincrassate; abaxial scales small, peltate, with cells of the disk indistinct.

This leaf anatomy is seen also in *Lindmania* in *L. tillandsioides*, *L. brachyphylla*, and the newly described *L. riparia*, and it is probably most closely related to these in spite of the shorter primary bracts or longer and laxer branching of the inflorescence that separate the species in the key. The new species seems to have the vascular bundles adaxially less recessed in the chlorenchyma than the other species.

Known only from the type.

2.2. *Lindmania saxicola* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 2, 27e-h. TYPE: Venezuela. Bolívar: Distrito Piar, Macizo del Chimantá-tepui, cabeceras del afluyente derecho superior del río Tirica ("Caño del Grillo"), ca. 2,450 m alt., Lat. 5°18'N, Long. 62°03'W, 7-8 Feb. 1983, *Julian A. Steyermark, Otto Huber & Victor Carreño E. 128945* (holotype, US; isotype, VEN).

Planta e fragmentis perveteribus solum cognita, florifera plus quam 46 cm alta. Folia superiora 13 cm longa; vaginis brevibus amplis; laminis anguste triangularibus, ad 12 mm latis, integris, utrinque minutissime obscureque lepidotis.

Scapus rectus, 5 mm diametro; scapi bracteis erectis, verisimiliter internodia superantibus. Inflorescentia laxa bipinnatim paniculata; bracteis primariis ignotis sed sine dubio ramorum basibus sterilibus brevissimis longioribus; ramis rectis, divergentibus, 8 cm longis, subdense florigeris. Bracteae floriferae angustissime triangulares, sepala subaequant, floribus sessilibus. Sepala late ovata, ca. 5 mm longa. Capsula ovoidea; seminibus bicaudatis.

Leaf anatomy. Vascular bundles not recessed in or covered by chlorenchyma adaxially, broadly covered by chlorenchyma abaxially; adaxial water storage cells multi-stratose, the outermost layer resiniferous; adaxial subepidermal cells uni-stratose, vertically elongate, incrassate, abaxial subepidermal cells tri-stratose, isodiametric, strongly incrassate; substomatal pores constricted between the oblong, resiniferous lateral subsidiary cells.

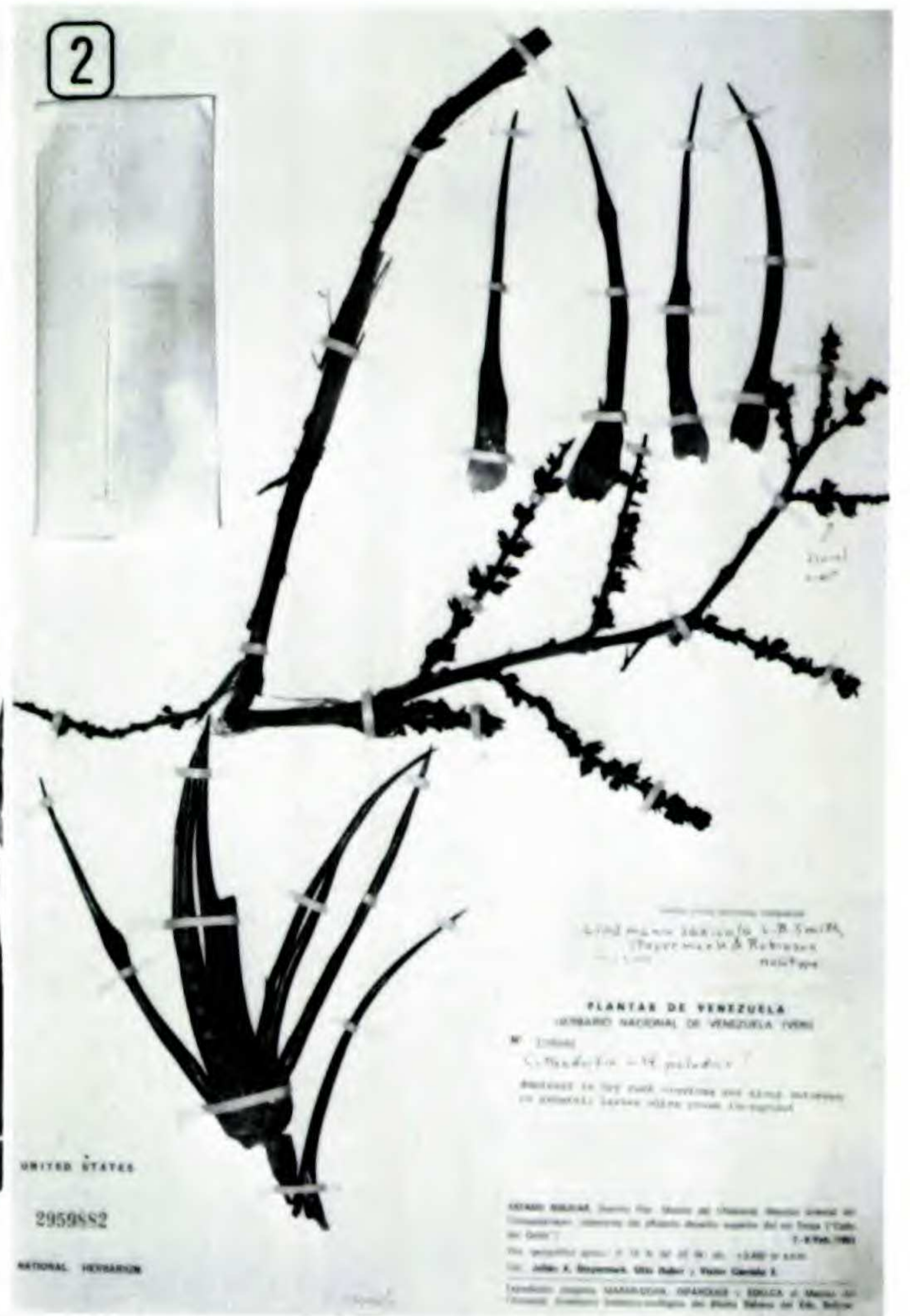
The species can be distinguished in *Lindmania* by the very thick subepidermal layering on the abaxial surface of the leaf and the constriction of the substomatal pore between the prominent lateral subsidiary cells. The massive abaxial chlorenchyma is like that previously noted in *L. subsimplex* which is possibly closely related.

Known only from the type.

3. *Lindmania gracillima* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia gracillima* L. B. Smith, Phytologia 7: 418, pl. 1, figs. 3-5. 1961.

4. *Lindmania wurdackii* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 284, fig. 13. 1957. *Cottendorfia wurdackii* (L. B. Smith) L. B. Smith, Phytologia 7: 171. 1960.

4.1. *Lindmania lateralis* (L. B. Smith & R. W. Read) L. B. Smith & H. Robinson, comb.



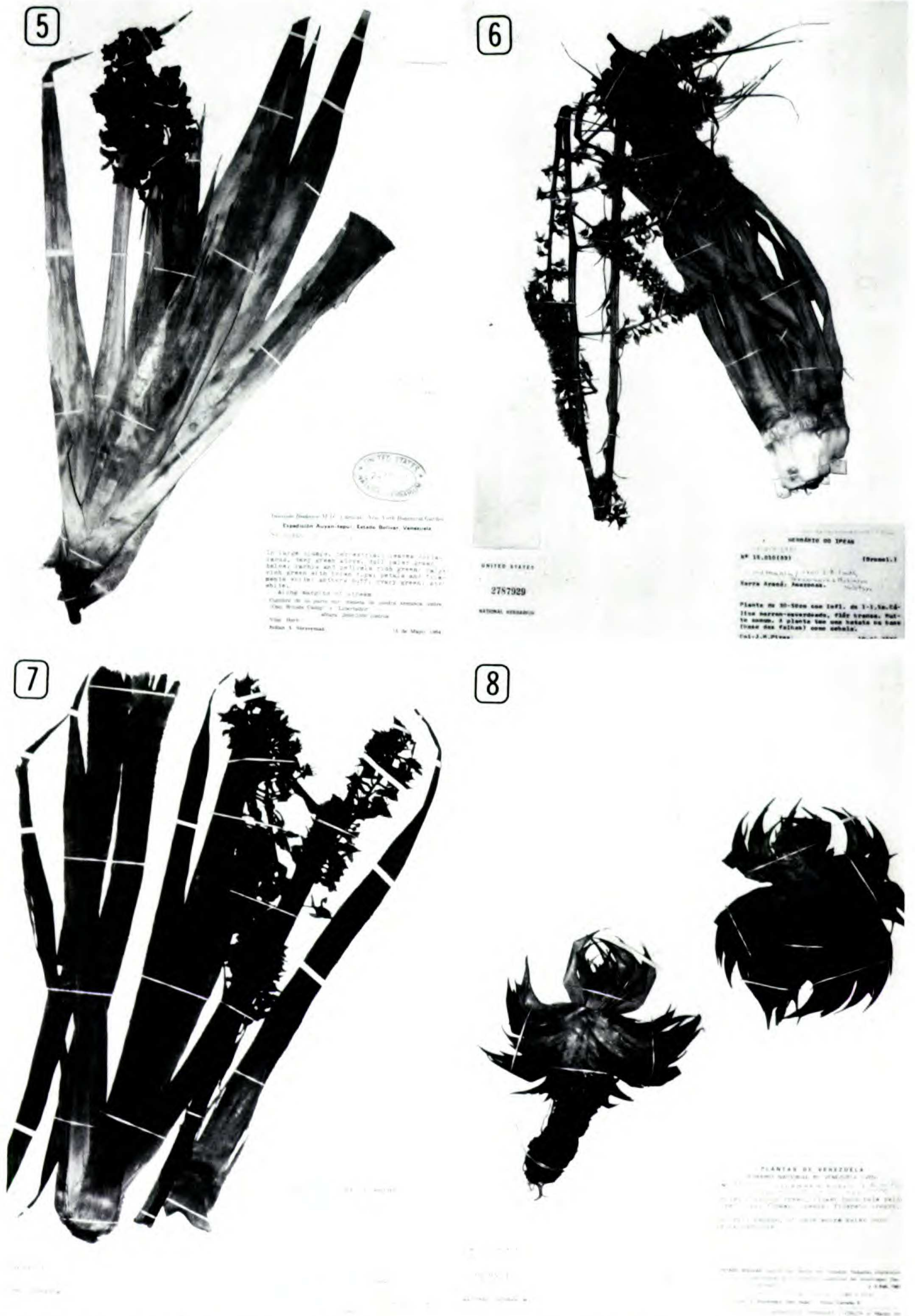
FIGURES 1-4.—1. *Lindmania sessilis*, Smith, Steyermark & Robinson.—2. *Lindmania saxicola* Smith, Steyermark & Robinson.—3. *Lindmania aurea* Smith, Steyermark & Robinson.—4. *Lindmania imitans* Smith, Steyermark & Robinson.

nov. *Cottendorfia lateralis* L. B. Smith & R. W. Read, *Phytologia* 30: 289, pl. 1. 1975.

The species description is emended by the following observations of leaf anatomy: Vascular bundles not covered with chlorenchyma adaxially or abaxially; adaxially water storage cells mostly 2–3-stratose, abaxially in distinct narrow canals; subepidermal cells adaxially 1–2-stratose, often resiniferous, not or scarcely incrassate; substomatal pores not occluded, oval or rounded; abaxial scales rudimentary, rarely with a few projecting cells.

The leaf cross-section is of the most typical *Lindmania* type as seen in *L. guianensis* and *L. argentea*.

5. *Lindmania paludosa* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 284, fig. 14. 1957. *Cottendorfia paludosa* (L. B. Smith) L. B. Smith, *Phytologia* 7: 170. 1960.
6. *Lindmania cylindrostachya* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 286, fig. 15. 1957. *Cottendorfia cylindrostachya* (L. B. Smith) L. B. Smith, *Phytologia* 7: 169. 1960.
7. *Lindmania savannensis* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia savannensis* L. B. Smith, Mem. N.Y. Bot. Gard. 10(2): 16, fig. 3. 1960.
- 7.1. *Lindmania atrorosea* (L. B. Smith, Steyermark & Robinson) L. B. Smith, comb. nov. *Cottendorfia atrorosea* L. B. Smith, Steyermark & Robinson in Steyermark et al., *Brittonia* 33: 28, figs. 1, 2E, F. 1981.
8. *Lindmania nubigena* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia nubigena* L. B. Smith, Mem. N.Y. Bot. Gard. 10(2): 16, fig. 2. 1960.
9. *Lindmania dyckioides* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia dyckioides* L. B. Smith, Mem. N.Y. Bot. Gard. 14(3): 21, fig. 1. 1967.
10. *Lindmania argentea* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 414, fig. 78. 1957. *Cottendorfia argentea* (L. B. Smith) L. B. Smith, *Phytologia* 7: 169. 1960.
11. *Lindmania phelpsiae* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 286, fig. 16. 1957. *Cottendorfia phelpsiae* (L. B. Smith) L. B. Smith, *Phytologia* 7: 170. 1960.
12. *Lindmania dendritica* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia dendritica* L. B. Smith, Mem. N.Y. Bot. Gard. 18(2): 31, fig. 5c. 1969.
13. *Lindmania longipes* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia longipes* L. B. Smith, Mem. N.Y. Bot. Gard. 14(3): 22, fig. 2. 1967.
14. *Lindmania geniculata* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 414, fig. 79. 1957. *Cottendorfia geniculata* (L. B. Smith) L. B. Smith, *Phytologia* 7: 170. 1960.
- 14b. *Lindmania geniculata* var. *minor* (L. B. Smith, Steyermark & Robinson) L. B. Smith, comb. nov. *Cottendorfia geniculata* var. *minor* L. B. Smith, Steyermark & Robinson in Steyermark et al., *Acta Bot. Venez.* 14(3): 15. 1984.
15. *Lindmania guianensis* (Beer) Mez, DC. Monogr. Phan. 9: 537. 1896. *Anoplophytum guianense* Beer, *Bromel* 44. 1857. *Cottendorfia guianensis* (Beer) Baker, *Handb. Bromel.* 129. 1889.
- 15b. *Lindmania guianensis* var. *vestita* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia guianensis* var. *vestita* L. B. Smith, *Phytologia* 7: 419. 1961.
16. *Lindmania maguirei* (L. B. Smith) L. B. Smith, comb. nov. *Cottendorfia maguirei* L. B. Smith, Mem. N.Y. Bot. Gard. 18(2): 31, fig. 5d, e. 1969.
17. *Lindmania brachyphylla* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 416, fig. 80. 1957. *Cottendorfia brachyphylla* (L. B. Smith) L. B. Smith, *Phytologia* 7: 169. 1960.
- 17b. *Lindmania brachyphylla* var. *angustior* (L. B. Smith, Steyermark & Robinson) R. W. Read, comb. nov. *Cottendorfia brachyphylla* var. *angustior* L. B. Smith, Steyermark & Robinson in Steyermark et al., *Brittonia* 33(1): 28. 1981.
18. *Lindmania steyermarkii* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 416, fig. 81. 1957. *Cottendorfia steyermarkii* (L. B. Smith) L. B. Smith, *Phytologia* 7: 170. 1960.
19. *Lindmania tillandsioides* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 416, fig. 82. 1957. *Cottendorfia tillandsioides* (L. B. Smith) L. B. Smith, *Phytologia* 9: 171. 1960.
- 19.1. *Lindmania riparia* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 5, 27q–t. TYPE: Venezuela. Bolívar: Auyan-tepui, along margins of stream, cumbre de la parte sur, meseta de piedra arenisca, entre “Oso Woods Camp” y “Libertador”, 2,050–2,300 m alt., 15 May 1964, Julian A. Steyermark 93895 (holotype, US; isotypes, MAC, NY).



FIGURES 5-8.—5. *Lindmania riparia* Smith, Steyermark & Robinson.—6. *Lindmania piresii* Smith, Steyermark & Robinson.—7. *Lindmania terramarae* Smith, Steyermark & Robinson.—8. *Lindmania huberi* Smith, Steyermark & Robinson.

Caulescens, florifera 2 dm alta, caule (apice) 1 cm diametro. Folia superiora 4 dm longa; vaginis vix distinctis; laminis lineari-lanceolatis, 35 mm latis, subtus minutissime lepidotis, angustissime albido-marginatis, basi minutissime denticulatis.

Scapus brevis, crassus; scapi bracteis foliaceis, erectis, dense imbricatis. Inflorescentia dense bipinnatim paniculata, 15 cm longa, trichomatibus subulatis fragilibus basi hemisphaericis persistentibus laxe vestita; bracteis primariis subfoliaceis, ramorum bases steriles superantibus. Bracteae floriferae lanceolatae, pedicellos crassos superantes; sepalis ellipticis, 5 mm longis, late albido-marginatis; petalis unguiculatis, albis (Steyermark).

Leaf anatomy. Vascular bundles adaxially deeply recessed in but not covered by chlorenchyma, abaxially narrowly covered by chlorenchyma; water storage cells adaxially 3–4-stratose, abaxially ca. 3-stratose in distinct canals; subepidermal cells in single subdistinct layers with slightly thickened walls; substomatal pores not occluded, oval to rounded with slightly thickened walls; abaxially with scales minute, irregularly peltate or shortly strap-shaped, with cells transversely oblong.

The leaf cross-section is like that seen in *Lindmania* in *L. tillandsioides*, *L. brachyphylla*, and the newly described *L. sessilis*. Both the key and the anatomy indicate closest relationship to *L. tillandsioides*. In spite of the close proximity in the key, *L. stenophylla* lacks the chlorenchyma abaxial to the vascular bundles, and it is probably not closely related.

Known only from the type.

20. *Lindmania subsimplex* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 417, fig. 83. 1957. *Cottendorfia subsimplex* (L. B. Smith) L. B. Smith, Phytologia 7: 170. 1960.

20.1. *Lindmania arachnoidea* (L. B. Smith, Steyermark & Robinson) L. B. Smith, comb. nov. *Cottendorfia arachnoidea* L. B. Smith, Steyermark & Robinson in Steyermark et al., Acta Bot. Venez. 14(3): 9, figs. 7, 10l–n. 1984.

20.2. *Lindmania aurea* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 3, 27i–m. TYPE: Venezuela. Bolívar: Distrito Piar, Macizo del Chimantá, pequeñas altiplanicies en la base septentrional de las farallones superiores del Amuri-tepui (Sector Oeste del Acopán-tepui), por escarpado encima de una cascada al oeste del acampamento, ca. 1,850 m alt., Lat. 5°10'N, Long. 62°07' Oeste, 2–

5 Feb. 1982, Julian A. Steyermark, Otto Huber & Victor Carreño E. 128611 (holotype, US; isotypes, NY, VEN).

Breviter caulescens, florifera ca. 20 cm alta, leviter curvata, ascendens. Folia densissime rosulata, ad 12 cm longa, squamis minutissimis orbicularibus dense sed obscure vestita; vaginis brevibus, latis; laminis angustissime triangularibus, longe attenuatis, 5 mm latis, integris.

Scapus gracillimus, glaber; scapi bracteis erectis, subfoliaceis, angustissimis quam internodis longioribus sed scapum haud occultantibus. Inflorescentia simplex, sublaxa, 7 cm longa, glabra. Bracteae floriferae eis scapi simulantes, pedicellos inferiores superantes; pedicellis divergentibus, gracilibus, ad 9 mm longis. Sepala ovata, obtusa, 3 mm longa, tenuia; petalis spatulatis, 10 mm longis, aureis (Steyermark); ovario supero; ovulis caudatis.

Leaf anatomy. Vascular bundles not covered by chlorenchyma adaxially, narrowly covered abaxially; adaxial water storage cells mostly 2–3-stratose, abaxially cells smaller and bistratose in distinct but nearly contiguous canals; subepidermal cells unistratose adaxially and abaxially, with walls thickened in exterior half; substomatal pores not occluded, oval or rounded; abaxially scales rudimentary, eccentrically peltate, sometimes strap-shaped, cells transversely oblong.

Leaf anatomy is notable for the rounded, non-recessed vascular bundles with a narrow abaxial covering of chlorenchyma and for the nearly continuous layer of abaxial water storage tissue. As such, the species does not seem closely related to most of the species with simple inflorescences with which it falls in the key. Closest relationship may be to *L. imitans* described below.

Known only from the type.

20.3. *Lindmania imitans* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 4, 27n–p. TYPE: Venezuela. Bolívar: Distrito Piar, Macizo del Chimantá, pequeñas altiplanicies en la base septentrional de los farallones superiores del Amuri-tepui (Sector W del Acopán-tepui), on vertical small bluff east of camp, Lat. 5°10'N, Long. 62°07'W, ca. 1,850 m alt., 2–5 February 1983, Julian A. Steyermark, Otto Huber & Victor Carreño E. 128474 (holotype, US; isotype, VEN).

Breviter caulescens, florifera ca. 9 cm alta, leviter curvata, ascendens. Folia densissime rosulata, ad 12 cm longa, squamis minutissimis orbicularibus dense sed obscure vestita; vaginis brevibus, latis; laminis anguste triangularibus, attenuatis, 10 mm latis, integris.

Scapus gracillimus, glaber; scapi bracteis erectis, dense

imbricatis, subfoliaceis. Inflorescentia simplex, laxa, 5 cm longa, glabra. Bracteae florigerae eis scapi simulantes, pedicellos inferiores subaequantibus; pedicellis divergentibus, gracilibus, ad 7 mm longis. Sepala suborbicularia, 3.5 mm longa; ovario supero.

Leaf anatomy. Vascular bundles not covered with chlorenchyma adaxially or abaxially, often with fiber-sheath extending to the epidermis; adaxial water storage cells 3–5-stratose; subepidermal cells smaller, unistratose, slightly incrassate; substomatal pores not occluded, oval or rounded; points of attachment of abaxial scales not seen, evidently very sparse.

The species has some resemblance to *L. aurea* with which it falls in the key, and it may be comparatively closely related. Nevertheless, the leaf cross-sections are strikingly different. The vascular bundles of the present species tend to be connected by fibers to the abaxial epidermis while the equivalent area in *L. aurea* is occupied by well developed water storage canals.

Known only from the type.

21. *Lindmania thyrsoidea* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 287, fig. 17. 1957. *Cottendorfia thyrsoidea* (L. B. Smith) L. B. Smith, Phytologia 7: 170. 1960.

21.1. *Lindmania smithiana* (Steyermark & Luteyn) L. B. Smith, comb. nov. For leaf anatomy see note under *Connellia varadarajanii*. *Connellia smithiana* Steyermark & Luteyn, Journ. Brom. Soc. 35: 152, fig. 3. 1985. Error in *C. varadarajanii* 35: fig. 1 on p. 52. 1985.

22. *Lindmania stenophylla* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 417, fig. 84. 1957. *Cottendorfia stenophylla* (L. B. Smith) L. B. Smith, Phytologia 7: 170. 1960.

23. *Lindmania minor* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 419, fig. 85. 1957. *Cottendorfia minor* (L. B. Smith) L. B. Smith, Phytologia 7: 170. 1960.

23.1. *Lindmania piresii* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 6, 27u–x. TYPE: Brazil. Amazonas: Serra Araca, 10 February 1975, *J. M. Pires 15.010(33)* (holotype, US; isotype, IPEAN).

Caulescens, florifera 1–1.5 m alta (Pires); caule 30–50 cm alto. Folia ultra 4 dm longa; vaginis ellipticis, 4 cm longis; laminis anguste triangularibus, perattenuatis, 18 mm latis, subtus trichomatibus fimbriatis albis vestitis, glabrescentibus, basi laxe serrulatis.

Scapus rectus, gracilis, glabrescens; scapi bracteis ex

basi brevi ovata longe angustissimeque laminatis, internodia superantibus. Inflorescentia laxa bipinnatim paniculata, glabrescens sed trichomatum basibus glanduliformibus persistentibus; bracteis primariis eis scapi similibus, ramorum bases subaequantibus; ramis patentibus, ad 12 cm longis, laxe florigeris. Bracteae florigerae triangulares, 2 mm longae; pedicellis patentibus, 4–5 mm longis. Sepala late ovata, obtusa, 3 mm longa, basi sulcata, apice scariosa; petalis 7 mm longis, albis.

Leaf anatomy. Vascular bundles not covered adaxially or abaxially by chlorenchyma; water storage cells forming distinct abaxial canals; subepidermal cells adaxially and abaxially 1–2-stratose, often resiniferous, not or scarcely incrassate; substomatal pores not occluded, oval or rounded; abaxial scales peltate, with a fringe of elongate, contorted cells.

The leaf cross-section is of the most typical *Lindmania* type as seen in *L. guianensis*, *L. argentea*, and relationship is probably to that group. Most of the related species can be distinguished by either having primary bracts in the inflorescence shorter than the sterile bases of the branches or having floral bracts equalling or exceeding the length of the pedicels.

Known only from the type.

23.2. *Lindmania terramarae* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 7, 29a–d. TYPE: Venezuela. Amazonas: Dept. Atabapo, Cerro Marahuaca, cumbre, extremo sureste, alrededor de una lagunita, altura 2,800 metros, Lat. 3°35'N, Long. 65°20' Oeste, 26 March 1983, *Julian A. Steyermark & Francisco Delascio 129067* (holotype, US; isotypes, NY, VEN).

Acaulis (Steyermark), e fragmentis solum cognita sed verisimiliter 2 m alta. Folia ca. 4 dm longa; vaginis brevibus amplis; laminis anguste triangularibus, ad 3 cm latis, base laxe spinoso-serrulatis, subtus lepidotis.

Scapus rectus, robustus, glaber; scapi bracteis erectis, inferioribus ignotis sed verisimiliter subfoliaceis dense imbricatisque, superioribus internodia paulo superantibus sed angustissimis et scapum haud occultantibus. Inflorescentia verisimiliter cylindrica, laxa bipinnatim paniculata, glabra; bracteis primariis angustissimis, quam ramorum basibus sterilibus longioribus; ramis suberectis vel divergentibus, ad 12 cm longis, sublaxe florigeris. Bracteae florigerae late ovatae attenuatae, 4 mm longae; pedicellis patentibus, gracilibus, 6 mm longis. Sepala late ovata, acuta, 5 mm longa, tenuia; petalis 12 mm longis. Capsula ovoidea.

Leaf anatomy. Vascular bundles recessed in chlorenchyma and reached by narrow extensions of water storage tissue adaxially and abaxially,

only smaller bundles sometimes covered abaxially; water storage cells adaxially and abaxially 2–3-stratose with tenuous walls, abaxially forming broad often contiguous canals; subepidermal cells 2–3-stratose adaxially and abaxially, firm and often resiniferous, walls thickened in only the exterior parts of the outermost cells; substomatal pores not occluded, oval; abaxially with numerous rudimentary scales that do not bear a distinct disc.

Lindmania terramarae shows the type of leaf anatomy common in the large typical group of *Lindmania*. It is probably most closely related to *L. marahuacae*, from the same mountain, with which it shares a comparatively glabrous condition. The new species differs by the taller, straighter inflorescence and the more verrucose leaves. Anatomically the leaves seem to have more highly developed layers of subepidermis, that layer being scarcely distinct in *L. marahuacae*.

23.3. ***Lindmania marahuacae*** (L. B. Smith, Steyermark & Robinson) L. B. Smith, comb. nov. *Cottendorfia marahuacae* L. B. Smith, Steyermark & Robinson in Steyermark et al., Acta Bot. Venez. 14, no. 3: 9, fig. 1, k–r. 1984.

24. *Lindmania navioides* L. B. Smith, Mem. N.Y. Bot. Gard. 9: 419, fig. 86. 1957. *Cottendorfia navioides* (L. B. Smith) L. B. Smith, Phytologia 7: 170. 1960.

24.1. ***Lindmania huberi*** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 8, 28a–d. TYPE: Venezuela. Bolívar: Distrito Pilar, Macizo del Chimantá, pequeñas altiplanicies en la base septentrional de los farallones superiores del Amurí-tepui (Sector Oeste del Acopan-tepui) en la base de cañon pequeño debajo del campamento donde el agua corre, ca. 1,850 m alt., Lat. ca. 5°10'N, Long. 62°07' Oeste, 2–5 February 1983, Julian A. Steyermark, Otto Huber & Victor Carreño E. 128465 (holotype, US; isotypes, NY, VEN). PARATYPE: Venezuela. Bolívar: Cumbre del Macizo de Chimantá, Sector nor-oriental, Tirepón (Torono)-tepui, Lat. 5°22'N, Long. 61°58' Oeste, 2,540 m alt., 24 February 1978, Julian A. Steyermark, Victor Carreño E., Roy McDiarmid & Charles Brewer-Carias 115846 (US, VEN).

Caulescens, florigera 13 cm alta, caule robustissimo ad 10 cm longo. Folia multa, in apicibus ramorum

dense rosulata, 9 cm longa; vaginis brevibus, omnino occultantibus; laminis anguste triangularibus, curvatis, eis inferioribus recurvatis, 10 mm latis, pungentibus, integris, glabris, glaucis (Steyermark), vix cretaceis.

Inflorescentia sessilis, corymbiformis, multiflora. Bractee florigerae angustissime triangulares; pedicellis elongatis, gracilibus. Sepala suborbicularia, 3.5 mm longa, libera, inflata, nervata, squamis minutissimis dense vestita; petalis spathulatis, 6 mm longis, cremeis (Steyermark); antheris suborbicularibus, equitantibus; ovario supero; ovulis caudatis.

Leaf anatomy. Vascular bundles not covered by chlorenchyma adaxially or abaxially, not recessed in chlorenchyma adaxially, with fiber sheath extending to the epidermis abaxially; water storage cells inflated, ca. 4-stratose; subepidermal cells on both surfaces in one layer, with walls slightly incrassate; substomatal pores not occluded, rounded; pits bearing abaxial scales not seen, evidently very sparse.

Abaxially buttressed vascular bundles have been previously noted in *Lindmania* in *L. navioides*, *L. minor*, *L. thyrsoides*, and the newly described *L. imitans*, all of which fall in separate places in the key, and none of which seem particularly closely related. Because of the sessile inflorescence, the new species keys out with *L. navioides*, but the latter represents a totally distinct element in the genus with elongate flexuous stems and densely imbricate, spreading, thin-textured leaves. The thicker leaves of *L. huberi* with the non-contoured upper epidermis indicate relationship to the more typical element of *Lindmania*.

Known only from the type and paratype.

5.1. **STEYERBROMELIA** L. B. Smith in Steyermark et al., Acta Bot. Venez. 14(3): 8. 1984. TYPE: *Steyerbromelia discolor* L. B. Smith & Robinson in Steyermark et al., sp. nov. Acta Bot. Venez. 14(8): 8. 1984.

Plants rosulate; leaves spinose-serrate, anatomy similar to *Lindmania* except substomatal pores usually partially occluded; inflorescence compound; flowers sessile, not or scarcely narrowed below; sepals imbricate; petals regular, appendaged with two vertically attached scales; stamens equal; ovary wholly superior, style branches often broadly lamelliform or lobed; seeds bicaudate.

The genus is known only from central Amazonas in Venezuela. Closest relationship is evidently to *Lindmania* from which it differs by the imbricated sepals and the appendaged petals.

Nomenclatural note: *Steyerbromelia* was originally prepared as a monotypic genus with *S. discolor* as the only species. *Steyerbromelia deflexa* was then added to the manuscript, but the resulting need to indicate a type species was overlooked. Cf. International Code Articles 37, 43.

- 1a. Branches suberect. Marahuaca 1. *S. discolor*
 1b. Branches decurved.
 2a. Leaf-blades glabrous. Duida 2. *S. deflexa*
 2b. Leaf-blades densely cinereous-lepidote
 beneath. Aratitiyope 3. *S. diffusa*

1. *Steyerbromelia discolor* L. B. Smith & Robinson in Steyermark et al., Acta Bot. Venez. 14(3): 8, figs. 2a–i, 6i–k. 1984.
 2. *Steyerbromelia deflexa* L. B. Smith & Robinson in Steyermark et al., Acta Bot. Venez. 14(3): 12, figs. 3a–f, 10i–k. 1984.
 3. ***Steyerbromelia diffusa*** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 9, 28e–i. TYPE: Venezuela. Amazonas: Dept. Río Negro, Cerro Aratitiyope, piedra ignea, 990–1,670 m alt., Lat. 2°10'N, Long. 65°34' Oeste, ca. 70 km SSO de Ocamo, con riachuelos afluente al río Manipitare, 24 Feb. 1984, Julian A. Steyermark, Paul Berry & Francisco Delascio 130072 (holotype, US; isotypes, NY, VEN).

Verisimiliter caulescens, florifera ultra 3 m alta. Folia ca. 1 m longa, rosulata, vetera patentia, juvenalia ascendentia, vaginis brevibus, amplis; laminis angustissime triangularibus, ca. 35 mm latis, supra lucidis, atro-viridibus (! Steyermark), mox glabris, subtus dense adpresseque cinereo-lepidotis, laxe spinoso-serrulatis.

Scapus cylindricus, glaber; scapi bracteis erectis, infirmis, subfoliaceis, internodia multo superantibus, supremis late ovatis, attenuatis. Inflorescentia laxissime 3-pinnatim paniculata; bracteis primariis late ovatis, acuminatis, quam ramorum basibus sterilibus elongatis multo brevioribus, ramis per anthesin divergentibus, ultra 6 dm longis, ramulis gracillimis, senectis decurvatis. Bractee florigerae reflexae, suborbiculares, 2 mm longae, apiculatae; floribus subsessilibus, patentibus. Sepala ovata, acuta, 5 mm longa, duabus inferioribus nervo mediano crasso auctis; petalis 7 mm longis, albis (Steyermark); ovario supero; ovulis caudatis.

Leaf anatomy. Vascular bundles not covered by chlorenchyma adaxially or abaxially, abaxially with fiber sheath extending to epidermis; adaxial water storage cells mostly 3–5-stratose, outermost and innermost mostly resiniferous; adaxial and abaxial subepidermal cells small, walls incrassate in part nearest epidermis, abaxial cells sporadically resiniferous; substomatal

cells with unthickened walls, bearing pairs of papillae protruding into pore; abaxially with subrotund scales, with smaller cells toward the dentate and denticulate margin.

Available material of flowers shows that the present species differs from the other two by the more elongate bases of its petals and its less broadened style branches. This third species of *Steyerbromelia* shows yet a third variation in the leaf cross-section with the vascular bundles extending abaxially to the epidermis. In *S. deflexa* the area abaxial to the bundles has a layer of chlorenchyma and one to three layers of small hyaline cells. In *S. discolor* the same area has well developed water storage canals. Nevertheless, evidence seems to show that the genus may be phyletically sound in spite of such differences. The new species and *S. discolor* have essentially identical structure of their abaxial leaf scales. Also, both have intrusions into their substomatal pores that is unlike any *Lindmania*. The third species, *S. deflexa*, has only rudimentary abaxial scales that cannot be compared while its substomatal pores tend to be somewhat irregular with some short intrusions.

Known only from the type.

8. **PITCAIRNIA** L'Héritier, Sert. Angl. 7. 1788; nom. conserv.

REVISED SEGMENTS OF KEY TO SUBGENUS *PEPINIA*

9. Inflorescence bipinnate; sepals acute.
 9a. Primary bracts of inflorescence narrowly triangular, acuminate, 10 cm long; pedicels stout, costate, ca. 10 mm long; floral bracts 10 mm long; sepals 35 mm long. Colombia, Venezuela 6. *P. bulbosa*
 9a. Primary bracts broadly ovate, to 6 cm long; pedicels slender, to 18 mm long; floral bracts 5 mm long; sepals 16 mm long. Brazil; Amazonas 6.1. *P. rondonicola*
 9. Inflorescence tripinnate; sepals obtuse, 20 mm long. Colombia 7. *P. heliophila*
-
- 30a. Scapes short, recurved; inflorescence densely flowered, secund; sepals filiform-attenuate. Yutaje 19.2. *P. nematophora*
 30a. Scapes erect; inflorescence lax, not secund; sepals acute.
 30b. Leaves densely furfuraceous beneath; petals ca. 50 mm long and 7 mm wide. Amazonas of Brazil and Venezuela
 19. *P. platypetala*
 30b. Leaves essentially glabrous on both surfaces; petals narrower. Tumaque-Humaque, Brazil 19.1. *P. sastrei*

- 6.1. *Pitcairnia rondonicola* L. B. Smith & R. W. Read, J. Brom. Soc. 36(1): 10, fig. 4. 1986.
19. *Pitcairnia platypetala* Mez in Mart., Fl. Bras. 3(3): 438. 1894, emend. L. B. Smith & Read, Brittonia 33: 33. 1981.
9. **BROCCHINIA** Schult. f. in Roem. & Schult. Syst. 7(2): lxx, 1250. 1830.
- 1a. Leaves and scape-bracts serrate; ovary only one-third inferior. Colombia, Venezuela 1. *B. serrata*
- 1b. Leaves and bracts always entire; ovary wholly or almost wholly inferior.
- 2a. Leaves even above, 14–30 cm long. Venezuela, Amazonas.
- 3a. Inflorescence glabrous or subglabrous, petals unguiculate. Cerro Sipapo (Paraque) 2. *B. maguirei*
- 3b. Inflorescence lepidote; petals elliptic or oblong-elliptic.
- 4a. Leaf-blades narrowly triangular; upper scape-bracts shorter than the internodes; sepals cucullate; inflorescence tripinnate. Duida 3. *B. vestita*
- 4b. Leaf-blades ligulate; scape-bracts all much exceeding the internodes.
- 5a. Inflorescence tripinnate; sepals and petals obtuse. Cerro Parú, Río Ventuari 4. *B. hitchcockii*
- 5b. Inflorescence bipinnate; sepals and petals acute. Cerro Moriche, Río Ventuari 5. *B. cowanii*
- 2b. Leaves prominently nerved on both sides, 16–120 cm long.
- 6a. Blades ligulate, rounded and apiculate.
- 7a. Inflorescence glabrous; stem columnar; plant to 8 m high. Eastern Bolívar and adjacent Guyana 11. *B. micrantha*
- 7b. Inflorescence lepidote.
- 8a. Branches strict, the lowest with the basal flowers covered by the large primary bracts; inflorescence very narrow. Amazonas: Cerro Yapacana 13. *B. cryptantha*
- 8b. Branches divergent to spreading, much exceeding the primary bracts; inflorescence broad.
- 9a. Central and secondary axes straight; leaves divergent to spreading.
- 10a. Leaf-blades very narrowly castaneous-margined; sepals oblong; petals unguiculate; styles free, thick. Southeastern Colombia and adjacent Venezuela 14. *B. paniculata*
- 10b. Leaf-blades concolorous; sepals and petals subequal, elliptic; styles basally connate, slender; plant highly variable. Bolívar and Amazonas 15. *B. tatei*
- 9b. Central and secondary axes flexuous or geniculate; leaves erect or suberect.
- 11a. Leaves forming a tight tube; scape about 3 mm in diameter, its upper bracts 1–2 cm long, remote; inflorescence rarely more than bipinnate. Bolívar and adjacent Guyana 17. *B. reducta*
- 11b. Leaves suberect, separate for most of their length; scape much stouter with large bracts; inflorescence distinctly tripinnate. Southeastern Colombia to eastern Venezuela 18. *B. hechtioides*
- 6b. Blades acute or acuminate.
- 12a. Blades subpetiolate, linear-lanceolate, 3 cm wide; inflorescence tripinnate; primary bracts shorter than the sterile bases of the branches. Bolívar: Uriman 6. *B. bernardii*
- 12b. Blades not constricted at base; inflorescence bipinnate to quadripinnate; primary bracts shorter than to slightly longer than the sterile bases of the branches.
- 13a. Blades with hard, thickened, pungent apices.
- 14a. Inflorescence densely lepidote; ovary sessile; blades subligulate. Neblina, Gran Sabana, Guyana 12. *B. steyermarkii*
- 14b. Inflorescence glabrous or subglabrous; ovary pedicellate; blades narrowly triangular.
- 15a. Leaf-sheaths and apices dark castaneous. Southern Venezuela 10. *B. melanacra*
- 15b. Leaf-sheaths and apices green.
- 16a. Capsules sharply 3-angled; inflorescence bipinnate, the ultimate branches elongate and laxly flowered. Gran Savanna, Cerro Yapacana 9. *B. prismatica*
- 16b. Capsules terete; inflorescence amply tripinnate, the ultimate branches short and densely flowered. Southeastern Colombia and southern Venezuela 8. *B. acuminata*
- 13b. Blades of the same texture throughout, ligulate or subligulate.
- 17a. Flowers secund; plant ca. 1.5 m high. Bolívar: Ptari-tepui 16. *B. secunda*
- 17b. Flowers polystichous; plant ca. 0.5 m high.

- 18a. Blades linear, 4 mm wide; inflorescence bipinnate. Neblina 7. *B. delicatula*
 18b. Blades ligulate, 20 mm wide; inflorescence tripinnate. Brazil: Amazonas: Rio da Serra Aracá 7.1. *B. amazonica*

7.1. *Brocchinia amazonica* L. B. Smith, Jour. Brom. Soc. 34: 106, fig. 4. 1984.

11. **NAVIA** Schult. f. in Roem. & Schult. Syst. 7(2): lxxv, 1195. 1830.

KEY TO SUBKEYS OF *NAVIA*

- 1a. Inflorescence laxly racemose or paniculate Subkey I
 1b. Inflorescence glomerate or moniliform-glomerate.
 2a. Ovary superior.
 3a. Sepals free.
 4a. Sepals acute or acuminate or attenuate, sometimes incurved but never cucullate Subkey II
 4b. Sepals obtuse or subacute, often cucullate Subkey III
 3b. Sepals connate posteriorly or equally Subkey IV
 2b. Ovary partly or almost wholly inferior Subkey V

Revised section of Subkey I

5. Spikes not strobilate, laxer.
 7. Sepals 2–5 mm long, not alate.
 8. Sepals ecarinate; plant little if any over 1 m high. Colombia 6. *N. garcia-barrigae*
 8. Posterior sepals carinate, plants 0.8–5 m high. Venezuela.
 8a. Inflorescence bipinnate; plant 0.8 m high. Neblina 6.1. *N. plowmanii*
 8a. Inflorescence amply 3–4-pinnate, plants 2–5 m high.
 9. Spikes digitate in threes, to 26 cm long. Amazonas: Cerro Sipapo (Paraque) 7. *N. brocchinioides*
 9. Spikes pinnate. Neblina.
 9a. Central floral axis stout; leaves to 4 dm long; blades 27 mm wide; inflorescence glabrous 8. *N. diffusa*
 9a. Central floral axis slender; leaves 6 dm long; blades 10 mm wide; inflorescence lepidote 8.1. *N. thomasii*

6.1. **Navia plowmanii** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 10, 28j–o. TYPE: Venezuela. Amazonas: Dept. Rio Negro, open rocky meadow on N facing slope with large granite outcrops, forming a ridge meadow at base of a large peak, vicinity of Camp VI, on a ridge on Venezuelan-Brazilian border, 3.5 km W of Pico Zuloaga, 2,000 m alt., Lat. 0°53'N, Long. 65°56'W, 13–15 April 1984, *W. W. Thomas & T. Plowman 3030* (holotype, US; isotypes, NY, VEN).

Planta vetusta solum cognita, caulescens, florigera 8 dm alta. Folia ad 14 cm longa; vaginis inconspicuis; laminis anguste triangularibus, 16 mm latis, supra glabris, subtus per aetatem glabrescentibus, laxe serrulatis.

Scapus 1 cm diametro, per aetatem glaber; scapi bracteis erectis, subfoliaceis, internodia superantibus sed vix occultantibus. Inflorescentia laxa bipinnatim paniculata; bracteis primariis late ovatis, quam ramorum basibus sterilibus brevioribus; ramis ad 7 cm longis. Bracteae florigerae late ovatae, acutae, quam sepalis subduplo brevioribus; floribus patentibus, sessilibus. Sepala imbricata, ovata, 4 mm longa; petalis ignotis; ovario supero; seminibus bicaudatis.

Leaf anatomy. Vascular bundles not covered by chlorenchyma adaxially; adaxial water storage cells multi-stratose, highly inflated, smaller outermost layer and innermost layer resiniferous; subepidermal cells resiniferous, adaxial narrow and strongly incrassate, abaxial similar, larger, less incrassate; substomatal pores nearly occluded, transversely elongate, halteriform; abaxial scales minute, eccentric, with transversely oblong cells.

This species is placed in *Navia* because of its imbricate sepals, although its appendaged seeds might suggest inclusion in *Lindmania*. Persistence of the ovule appendages into the mature state has been noted before in at least one other species of *Navia*, *N. scirpiflora*. As in that previous case, the presence of occluded substomatal pores confirms the generic placement in *Navia*.

Known only from the type.

8.1. **Navia thomasii** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 11, 28p–s. TYPE: Venezuela. Amazonas: Dept. Río Negro, dry

forest and scrub vegetation on ESE facing slope above Río Marawinuma E of "Puerto Chimo" camp, dominant on open slope, ca. 600 m alt., Lat. 0°50'N, Long. 66°07'W, 26 April 1984, *W. W. Thomas 3245* (holotype, US; isotypes, NY, VEN).

Planta e fragmentis solum cognita, florigera verisimiliter ca. 2 m alta. Folia superiora ad 6 dm longa; vaginis inconspicuis; laminis angustissime triangularibus, 10 mm latis, supra glabris, subtus dense albido-lepidotis, laxe serrulatis.

Scapus 8 mm diametro, glabrescens; scapi bracteis erectis, foliaceis. Inflorescentia laxissime 4-pinnatim paniculata, lepidota; bracteis primariis verisimiliter late ovatis et quam ramorum basibus sterilibus multo brevioribus, ramis ad 25 cm longis. Bractee florigerae late ovatae, quam sepalis duplo brevioribus; floribus patentibus, sessilibus. Sepala ovata, acuta, libera, 4 mm longa, ea posteriora obtuse carinata; petalis 6 mm longis, albis (Thomas); ovario supero.

Leaf anatomy. Vascular bundles not covered by chlorenchyma adaxially or abaxially, abaxially with fiber sheath reaching the epidermis; water storage cells multi-stratose, sporadically resiniferous, interior cells more tenuous, innermost less resiniferous; subepidermal cells adaxially small, incrassate, abaxially 1–2-stratose, scarcely incrassate, resiniferous; substomatal pore nearly occluded, transversely elongate, halteriform; abaxially scales small, peltate, lobed, with indistinct cells.

AMENDED SECTIONS OF SUBKEY II

3. Omit lead to 13. *Navia lopezii*, which proves to be a member of the Xyridaceae.

9. Sepals 12–18 mm long; floral bracts straight; leaf-blades serrulate.

10. Sepals glabrous or glabrescent, acute, inflorescences as in 11.

10a. Inflorescence 15 mm in diameter, green. Duida 19. *N. steyermarkii*

10a. Inflorescence 40–50 mm in diameter, pink to red. Guanay, Yutaje 20. *N. phelpsiae*

10. Sepals laxly filamentous-lepidote, broadly acute, narrowly alate-carinate; inflorescence red, 2 cm in diameter. Duida-Huachamacari 20.1. *N. aliciae*

16. Sepals 5–8 mm long.

16a. Inflorescence compound, digitate-globose from several ellipsoid spikes, many-flowered.

16b. Inflorescence sessile; floral bracts broadly ovate, acute, about

equaling the sepals. Amazonas-adjacent Brazil 25. *N. crispa*

16b. Inflorescence scapose; floral bracts ovate, long-attenuate, exceeding sepals. Amazonas: Río Marawinuma

..... 25.1. *N. polyglomerata*

16a. Inflorescence simple, hemispherical, sessile. Amazonas: Duida-Río Orinoco 25.2. *N. huberiana*

Navia lopezii should be transferred from the Bromeliaceae and placed in the Xyridaceae. The distinctive epidermis and lack of trichomes in the species have previously been noted by Robinson (1969). The species and its variety are disposed as follows:

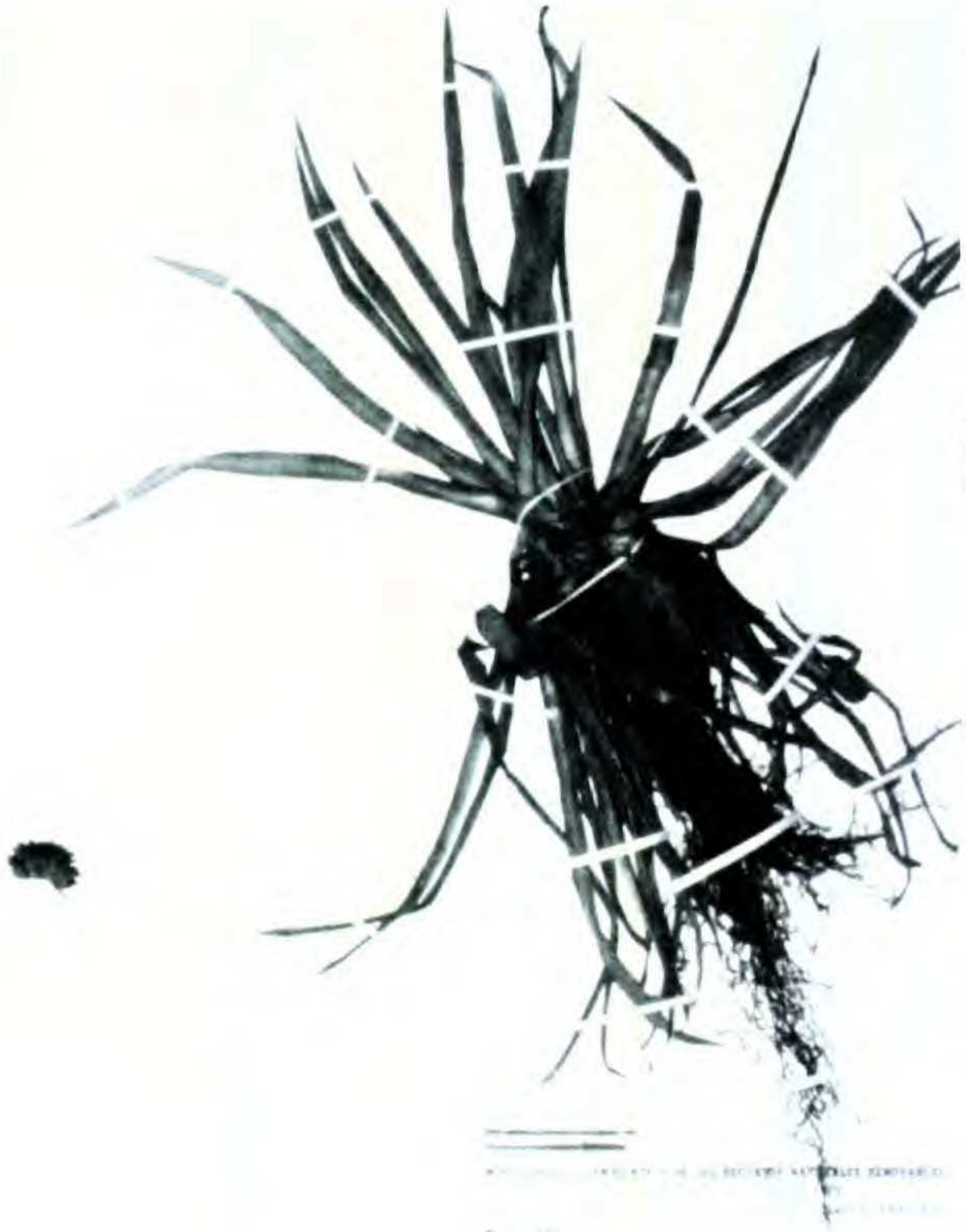
13. *Araratitiopea lopezii* (L. B. Smith) Steyermark & Berry, Ann. Missouri Bot. Gard. 71: 297, fig. 1. 1984. *Navia lopezii* L. B. Smith, Bot. Mus. Leafl. Harvard 15: 40. 1951; 16: 195, pl. 28. 1954; Fl. Neotrop. no. 14(1): 465, fig. 163L, M. 1974.

- 13b. *Araratitiopea lopezii* var. *colombiana* (L. B. Smith) Steyermark & Berry, Ann. Missouri Bot. Gard. 71(1): 299. 1984. *Navia lopezii* var. *colombiana* L. B. Smith, Bot. Mus. Leafl. Harvard 16: 195. 1954; Fl. Neotrop. no. 14(1): 465. 1974.

- 20.1. *Navia aliciae* L. B. Smith, Steyermark & Robinson in Steyermark et al., Acta Bot. Venez. 14 (3): 13, figs. 9a–f, 10a–e. 1984.

- 25.1. ***Navia polyglomerata*** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 12, 28t–z. TYPE: Venezuela. Amazonas: On banks of Río Marawinuma, 2–6 km east of Base Camp, 160 m alt., Lat. 0°50'N, Long. 66°08'W, 26 April 1984, *W. W. Thomas 3261* (holotype, US; isotypes, NY, VEN). PARATYPES: Venezuela. Amazonas: Common on open slopes at ca. 550 m alt., dry forest and scrub vegetation on ESE facing slope on Río Marawinuma, east of "Puerto Chimo" camp, Lat. 0°50'N, Long. 66°07'W, 26 April 1984, *W. W. Thomas 3257* (NY, US, VEN). Dept. Río Negro: on moss-covered bank, 5–10 km east of Cerro de Neblina Base Camp which is on Río Marawinuma, Puerto Chimo Camp, 150 m alt., Lat. 0°50'N, Long. 66°07'W, 9 Feb. 1984, *R. Liesner & Charles Brewer 15807* (MO, US). Puerto Chimo Camp and up north slope of canyon, 5 km east of La Neblina Base Camp by air, 150–1,800 m, Lat. 0°50'N, Long. 66°07'W,

13



HERBARIUM OF THE UNIVERSITY OF CALIFORNIA
No. 303
Date: 1954
Collector: S. G. Smith & R. Robinson
Locality: Steyermark, Austria
Altitude: 1000 m
DISEASE
NATIONAL HERBARIUM

14



INSTITUTO NACIONAL DE PARQUES
Herbario Nacional de Venezuela
FLORA DE VENEZUELA
No. 12886
Date: 1954
Collector: S. G. Smith & R. Robinson
Locality: Steyermark, Austria
Altitude: 1000 m
DISEASE
NATIONAL HERBARIUM

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No. 303
Date: 1954
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Locality: Steyermark, Austria
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16



UNITED STATES
2980870
NATIONAL HERBARIUM

INSTITUTO NACIONAL DE PARQUES
Herbario Nacional de Venezuela
FLORA DE VENEZUELA
No. 12886
Date: 1954
Collector: S. G. Smith & R. Robinson
Locality: Steyermark, Austria
Altitude: 1000 m
DISEASE
NATIONAL HERBARIUM

FIGURES 13-16.—13. *Navia huberiana* Smith, Steyermark & Robinson.—14. *Navia pedemontana* Smith, Steyermark & Robinson.—15. *Navia crassicaulis* Smith, Steyermark & Robinson.—16. *Navia linearis* Smith, Steyermark & Robinson.

11 Feb. 1984, R. Liesner & Charles Brewer 15875 (MO, US).

Caulescens; caule erecto, robusto (ad 1 m alto). Folia ad 3(-4) dm longa; vaginis parvis, inconspicuis; laminis angustissime triangularibus, 7(-15) mm latis, utrinque trichomatibus subulatis fragilibus basi semiglobosis persistentibus laxe vestitis, integris, margine recurvatis, siccis linea mediana pallida auctis.

Scapus erectus, gracilis, 4 cm longus, sulcatus, trichomatibus eis laminarum similibus vestitus; scapi bracteis foliaceis, longissimis. Inflorescentia e spicis 5-7 digitata; bracteis primariis eas superiores scapi simulantibus, inflorescentiam superantibus; spicis ellipsoideis, dense multifloris, 25 mm longis. Bractee florigerae dense imbricatae, ovatae, longe attenuatae, sepala superantes. Sepala libera, posteriora anguste triangularia, acuta, carinata, 8 mm longa, glabra; petalis albis (Thomas). Capsula subglobosa, 3 mm longa; seminibus in loculis solitariis, exappendiculatis.

Leaf anatomy. Vascular bundles narrowly covered by chlorenchyma adaxially and abaxially, narrower abaxially; water storage cells adaxially 1-3-stratose toward the margins, in the middle multistratose, abaxially in distinct canals under the vascular bundles; adaxial and abaxial subepidermal cells mostly indistinct, not incrassate, multistratose and incrassate adaxially in the middle of the leaf; substomatal pores not occluded, oval; abaxial surface with rudimentary uniseriate hairs.

The species could be close to *N. crispa* and other non-scapose species on the basis of leaf anatomy. The more strongly scapose *N. caulescens* of Colombia also seems related in spite of its multiseriate trichomes.

Known only from the Neblina area.

25.2. *Navia huberiana* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 13, 29e-h. TYPE: Venezuela. Amazonas: Dept. Atabapo, terrestre sobre los taludes de un caño, frecuente, bancos arenosos de un caño a unos 12 km al W de Esmeralda, entre el Cerro Duida y el Río Orinoco, preparado de material vivo entregado al Dr. Steyermark en Caracas, ca. 125 m alt., Lat. 3°11'N, Long. 65°37'W, 7 March 1980, O. Huber 5058 (holotype, US; isotype, VEN).

Caulescens; caule erecto, brevi. Folia ad 13 cm longa; vaginis parvis, inconspicuis; laminis angustissime triangularibus, 6 mm latis, utrinque trichomatibus subulatis fragilibus basi semiglobosis persistentibus laxe vestitis, serrulatis, planis vel margine incurvatis, siccis linea mediana pallida auctis.

Inflorescentia sessilis, simplex, semiglobosa; bracteis primariis foliaceis, inflorescentiam superantibus. Bractee florigerae ovatae, attenuatae, sepala superantes, virides, albo-tomentosae. Sepala libera, ovata, acuta, 7 mm longa, castanea, albo-tomentosa; ovario supero.

Leaf anatomy. Vascular bundles broadly covered by chlorenchyma adaxially and abaxially; subepidermal cells adaxially distinct, abaxially indistinct; substomatal cells with wall not incrassate, with paired simple papillae projecting into pore from each side; abaxially with short, uniseriate bulbous-based hairs.

The leaf section and the uniseriate hairs would place the new species in the general relationship of *Navia crispa*, but *N. huberiana* differs in the broader abaxial chlorenchyma over the veins and the paired simple papillae projecting into the substomatal pores.

Known only from the type.

Revised Subkey III

1. Inflorescence or its branches digitate-compound.
 2. Inflorescence slenderly scapose. Bolívar: Jáua.
 3. Cluster of spikes single 39.3. *N. luzuloides*
 3. Clusters of spikes many, widely spaced on a long axis 39.4. *N. scirpiflora*
 2. Inflorescence sessile or subsessile.
 4. Inner leaf-blades white at anthesis; sepals 10 mm long, much exceeding the floral bracts. Bolívar: Jáua 39.2. *N. jauana*
 4. Inner leaf-blades like those below.
 5. Sepals 13-14 mm long.
 6. Floral bracts ovate, attenuate; leaves 10 cm long, the blades 9 mm wide, involute. Bolívar: Jáua 39. *N. robinsonii*
 6. Floral bracts broadly rounded and apiculate; leaves over 30 cm long, the blades 17 mm wide, flat. Amazonas: Río Cunucunuma 39.1. *N. pedemontana*
 5. Sepals 7-7.5 mm long. Bolívar.
 7. Floral bracts broadly ovate, about equaling the sepals; leaves 30 cm long, the blades 9 mm wide. Ichún 40. *N. navicularis*
 7. Floral bracts suborbicular, distinctly shorter than the sepals; leaves 3 cm long, the blades 20 mm wide. Jáua 41. *N. breweri*

1. Inflorescence simple.
 8. Leaf-blades 8–20 mm wide.
 9. Keel of the posterior sepals dilated below the apex; inflorescence few-flowered. Amazonas: Duida 35. *N. xyridiflora*
 9. Keel of the posterior sepals linear or broader at base or middle.
 10. Sides of the posterior sepals 1 mm wide, their keels very narrow.
 11. Leaf-blades densely cinereous-lepidote beneath, their sides contrasting.
 12. Leaves and bracts finely subulate-attenuate; posterior sepals incurved but not cucullate. Amazonas: Marahuaca 36. *N. pauciflora*
 12. Leaves and bracts apically thickened and obtuse; sepals cucullate. Bolívar: Jáua 37. *N. incrassata*
 11. Leaf-blades sparsely lepidote on both sides, becoming glabrous.
 13. Floral bracts oblong, broadly acute. Bolívar: Pauo, Río Caura 38. *N. caurensis*
 13. Floral bracts broad, broadly rounded.
 14. Floral bracts suborbicular, entire. Bolívar: Guaiquinima 38.1. *N. ovoidea*
 14. Floral bracts oblong, serrulate, cucullate. Amazonas: Duida 38.2. *N. albiflora*
 10. Sides of the posterior sepals 2 mm wide, their keels narrow or broad.
 15. Leaf-blades cretaceous beneath. Amazonas.
 16. Floral bracts serrulate; sepals strongly nerved, lepidote; leaf-blades 20 mm wide. Duida 44. *N. latifolia*
 16. Floral bracts entire; sepals even, glabrous; leaf-blades 13 mm wide. Huachamacari 45. *N. cretacea*
 15. Leaf-blades sparsely and minutely lepidote on both sides, becoming glabrous.
 17. Inflorescence subglobose.
 18. Floral bracts pandurate, broadly rounded and apiculate, serrulate, lepidote; blades glabrous. Amazonas: Duida 42. *N. octopoides*
 18. Floral bracts acute, the inner ones entire, glabrous; leaf-blades white-barbellate in the axils of the spines. Guyana 43. *N. barbellata*
 17. Inflorescence narrow, largely covered by the subfoliaceous bracts. Amazonas.
 19. Leaf-blades narrowly triangular, 18 mm wide; caudex stout, 30 cm tall. Neblina 43.1. *N. crassicaulis*
 19. Leaf-blades linear, contracted toward base, 9 mm wide; caudex short. Marahuaca 43.2. *N. linearis*
8. Leaf-blades not over 6 mm wide.
 20. Leaf-blades entire or serrulate only near base, 6–20 cm long, most species over 12 cm long.
 21. Floral bracts obtuse.
 22. Leaf-blades covered beneath with appressed cinereous scales; leaf blades 5 mm wide. Amazonas: Yutaje 51. *N. umbratilis*
 22. Leaf-blades glabrescent except for the densely white-ciliate margins.
 23. Leaves numerous; blades mostly 3 mm, rarely to 5 mm wide; inflorescence many-flowered, ovoid. Amazonas: Cerro Vinilla 51.1. *N. culcitaria*
 23. Leaves relatively few; blades uniformly 5 mm wide; inflorescence few-flowered, fasciculate. Brazil: Amazonas 51.2. *N. piresii*
 21. Floral bracts acute. Amazonas.
 24. Leaf-blades 20 cm long, 3 mm wide, the inner ones white at base. Cerro Vinilla 51.3. *N. berryana*
 24. Leaf-blades 6–12 cm long, 3–6 mm wide.
 25. Blades covered beneath with appressed white scales. Moriche 52. *N. semiserrata*
 25. Blades laxly vestite beneath and on the margins with filamentous white trichomes. Neblina 52.1. *N. filifera*
20. Leaf-blades serrulate throughout, 4–10 cm long.
 26. Blades covered beneath with white appressed scales. Bolívar: Jáua 50. *N. lasiantha*
 26. Blades soon glabrous on both sides.
 27. Floral bracts obtuse or apiculate; posterior sepals cucullate or obtuse.
 28. Blades with a median white stripe when dry, uniform; floral bracts and sepals membranaceous, transparent. Amazonas: Neblina 50.1. *N. liesneri*
 28. Blades dimorphic, the inner ones basally pale.
 29. Floral bracts thickened at apex; posterior sepals cucullate. Bolívar: Guaiquinima 47. *N. cucullata*
 29. Floral bracts uniformly membranaceous; posterior sepals obtuse. Amazonas: Cerro Vinilla 47.1. *N. delascionis*
 27. Floral bracts acute; posterior sepals cucullate.
 30. Floral bracts thickened at apex. Bolívar.
 31. Leaf-blades abruptly acute. Jáua 48. *N. intermedia*
 31. Leaf-blades evenly filiform-attenuate. Marutani 48.1. *N. geaster*

30. Floral bracts uniformly thin.
32. Lowest floral bracts serrulate near apex, red-brown; inner leaves not pale at base, leaf-blades 2.5 mm wide. Bolívar: Río Caura, Jáua 46. *N. cardonae*
32. Lowest floral bracts and all others entire, green; inner leaves pale at base.
33. Floral bracts broadly elliptic, acute and mucronulate, about equaling the sepals; leaf-blades 3–5 mm wide. Amazonas: Neblina 49. *N. abysmophila*
33. Floral bracts ovate, acuminate, shorter than the sepals; leaf-blades 2.5 mm wide. Bolívar: Guaiquinema 49.1. *N. emergens*

38.1. *Navia ovoidea* L. B. Smith, Steyermark & Robinson in Steyermark et al., Brittonia 33: 31, fig. 2C, D. 1981.

38.2. *Navia albiflora* L. B. Smith, Steyermark & Robinson in Steyermark et al., Acta Bot. Venez. 14(3): 11, figs. 8, 10f–h. 1984.

39.1. ***Navia pedemontana*** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 14, 29i–l. TYPE: Venezuela. Amazonas: Dept. Atabapo, orilla de una quebrada, vecinidad de la cominidad de Culebra, río Cunucunuma, 200–220 m alt., Lat. 3°40'N, Long. 65°45'W, 22–23, 28–29 March, 1–4 April 1983, *Julian A. Steyermark & Francisco Delascio 129063* (holotype, US; isotype, VEN).

Caulescens; caule sursum curvato, 10 cm longo. Folia ultra 3 dm longa; vaginis parvis, atris; laminis linearibus, 17 mm latis, apice attenuatis, ad basin versus paulo contractis, planis, mox glabris, serrulatis, siccis linea mediana pallida auctis.

Inflorescentia sessilis, e spicis 3 dense digitata; bracteis primariis subfoliaceis, inflorescentiam multo superantibus; spicis dense ovoideis, ea centrali 2 cm longa, lateralibus multo minoribus. Bractee florigerae sepala subaequant, late rotundatae apiculataeque. Sepala libera, 14 mm longa, posterioribus anguste oblongis, latere 1 mm latis, obtusis; petalis albis (Steyermark & Delascio); ovario supero.

Leaf anatomy. Vascular bundles mostly narrowly covered with chlorenchyma adaxially; adaxial water storage cells ca. 3-stratose; adaxial and abaxial subepidermal cells indistinct, not incrassate; substomatal cells with walls not thickened, with pairs of simple papillae projecting into pore on each side; scales peltate, slightly lobed, walls of cells indistinct.

On the basis of leaf-anatomy the new species falls closer to *N. semiserrata* than any near which it is placed in the key. None of the other species with complex inflorescences have such open substomatal pores with simple pairs of papillae. *Navia navicularis* and *N. breweri* differ further by having hairs rather than scales on the leaves.

Known only from the type.

39.2. *Navia jauana* L. B. Smith, Steyermark & Robinson in Steyermark & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 22(132–133): 287, fig. 5. 1976.

39.3. *Navia luzuloides* L. B. Smith, Steyermark & Robinson in Steyermark & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 22(132–133): 289, fig. 6. 1976.

39.4. *Navia scirpiflora* L. B. Smith, Steyermark & Robinson in Steyermark & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 22(132–133): 307, fig. 7. 1976.

43.1. ***Navia crassicaulis*** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 15, 29m–s. TYPE: Venezuela. Amazonas: Dept. Río Negro, Camp III, Neblina and Massif, NW Plateau (arm), 13.5 km ENE of Cerro de La Neblina Base Camp, 1,750–1,850 m alt., Lat. 0°54'N, Long. 66°04'W, 16–18 February 1984, *Ronald Liesner 16026* (holotype, US; isotype, MO).

Caulescens; caule erecto, robusto, 30 cm alto. Folia 20 cm longa; vaginis brevibus, atris; laminis anguste triangularibus, 18 mm latis, utrinque trichomatibus subulatis fragilibus basi semiglobosis persistentibus laxe vestitis, laxe serrulatis.

Inflorescentia terminalis, sessilis; bracteis primariis foliaceis, inflorescentiam multo superantibus. Bractee florigerae late obovatae, apice apiculatae serrulataeque. Sepala libera, posterioribus lanceolatis, obtusis, cucullatis, 10 mm longis; ovario supero.

Leaf anatomy. Vascular bundles adaxially maximally and abaxially minimally covered by chlorenchyma; water storage cells forming distinct abaxial canals; adaxial subepidermal cells in 3–4 layers, resiniferous, exterior cells in part with thickened walls; abaxial subepidermal cells resiniferous, unistratose; substomatal pores not occluded, oval; abaxial scales minute, peltate.

On the basis of leaf anatomy the species falls closest to such Colombian species as *Navia acaulis*, *N. bicolor*, and *N. heliophila*, which have connate sepals. The species placed close in the

above key all differ by having variously occluded substomatal pores, and most have no abaxial water storage canals.

Known only from the type.

- 43.2. *Navia linearis* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 16, 30a–e. TYPE: Venezuela. Amazonas: Dept. Atabapo, Cerro Marahuaca, shaded face of wet sandstone bluff, southwest-facing slopes, headwaters of Río Iguapo, southern sector of Meseta Sur-Este, 1,560 m alt., Lat. 3°36'00"N, Long. 65°23'10"W, 13–14 October 1983, *Julian A. Steyermark 129646* (holotype, US; isotype, VEN).

Caulescens; caule erecto, 10 cm alto. Folia 12 cm longa; vaginis brevibus; laminis linearibus, 9 mm latis, apice attenuatis, basi paulo contractis, utrinque trichomatibus subulatis fragilibus basi semiglobosis persistentibus laxe vestitis, laxe serrulatis.

Inflorescentia terminalis, sessilis, pauciflora; bracteis primariis subfoliaceis, inflorescentiam multo superantibus. Bractee florigerae oblongae, obtusae, membranaceae, integrae. Sepala libera, posterioribus linearibus, obtusis, cucullatis, 10 mm longis; petalis albis (Steyermark); ovario supero.

Leaf anatomy. Vascular bundles narrowly covered by chlorenchyma adaxially and abaxially; subepidermal cells slightly differentiated, not incrassate; substomatal cells with walls not thickened, with pairs of commonly lobed or flexuous papillae protruding into pore on each side; scales minute, obsolete peltate.

The combination of geography, floral characters in the key above, and the commonly lobed papillae of the substomatal pores would indicate closest relationship of the new species is to *Navia latifolia* and *N. cretacea*. The last two are distinguished by the cretaceous leaf undersurfaces.

Known only from the type.

- 47.1. *Navia delascionis* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 21, 31h–n. TYPE: Venezuela. Amazonas: Dept. Río Negro, in exposed drier places of savanna, on outcrops of quartzite, vicinity and northward from Cerro Vinilla, 440–600 m alt., Lat. 2°31'N, Long. 65°23'W, 1–2 March 1984, *Steyermark, Berry & Delascio 130410* (holotype, US; isotype, VEN).

Caulescens; caule erecto, 8 cm alto. Folia 10 cm longa; vaginis parvis, atris; laminis anguste triangularibus, 3 mm latis, albo-ciliatis, alibi mox glabris, laxe serrulatis, interioribus ad basin versus albis.

Inflorescentia terminalis, sessilis, anguste ovoidea, 2 cm alta, atrocastanea; bracteis primariis subfoliaceis, inflorescentiam superantibus. Bractee florigerae ellipticae, quam sepalis paulo breviores, membranaceae, rubro-brunneae. Sepala libera, posterioribus linearibus, obtusis, 10 mm longis; ovario supero.

Leaf anatomy. Vascular bundles covered by chlorenchyma adaxially and abaxially; the innermost adaxial water storage cells sporadically resiniferous; subepidermal cells mostly unistratose, abaxially mostly resiniferous; substomatal pores nearly occluded, transversely elongate, halteriform; abaxial scales not evident.

The new species seems rather distinct among those with nearly occluded substomatal pores by the broad covering of chlorenchyma adaxially over the vascular bundles. Of the species placed close in the above key, relationship is perhaps closest to some from western Bolívar such as *Navia lasiantha* and *N. cardonae*.

Known only from the type.

- 48.1. *Navia geaster* L. B. Smith, Steyermark & Robinson in Steyermark et al., *Acta Bot. Venez.* 14(3): 14, fig. 2j–p. 1984.
- 49.1. *Navia emergens* L. B. Smith, Steyermark & Robinson in Steyermark et al., *Brittonia* 33: 31, fig. 2A, B. 1981.
- 50.1. *Navia liesneri* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 21, 31a–g. TYPE: Venezuela. Amazonas: Dept. Río Negro, Cerro de Neblina, Puerto Chimo Camp on Río Mawarinuma and up north slope of canyon, 150–1,800 m alt., Lat. 00°50'N, Long. 66°07'W, 11 February 1984, *Ronald Liesner & Charles Brewer 15866* (holotype, US; isotype, MO).

Caulescens; caule erecto, ca. 11 cm alto. Folia 7 cm longa; vaginis parvis, a laminis omnino occultis; laminis anguste triangularibus, 4 mm latis, siccis linea mediana alba auctis aliter uniformibus, alto-ciliatis, alibi glabris, laxe serrulatis.

Inflorescentia terminalis, sessilis, subglobosa, 12 mm diametro; bracteis involucrantibus foliaceis, inflorescentiam superantibus. Bractee florigerae ellipticae, obtusae, sepala subaequantes, membranaceae, transparentes. Sepala libera, posterioribus linearibus, obtusis, 9 mm longis; ovario supero.

Leaf anatomy. Vascular bundles not or scarcely covered by chlorenchyma adaxially and abaxially; water storage cells forming slightly distinct abaxial canals; subepidermal cells incrassate, unistratose; substomatal pores not occlud-



FIGURES 21-24.—21. *Navia liesneri* Smith, Steyermark & Robinson.—22. *Navia delascionis* Smith, Steyermark & Robinson.—23. *Navia igneocicola* Smith, Steyermark & Robinson.—24. *Brewcaria marahuacae* Smith, Steyermark & Robinson.

ed, rounded or oval; abaxial scales small, peltate, lobed, with cells indistinctly oblong.

The leaf anatomy, with the vascular bundles exposed both dorsally and ventrally to water storage tissue, and substomatal pores without intrusions, is a combination commonly seen in *Lindmania*, but such a combination distinguishes the new species from all previously known species of *Navia*. All the features of the new species, however, are found independently in various species of *Navia* and the combination was to be expected in the genus. The non-occluded substomatal pores alone distinguish the species from all others placed with it in the above key on the basis of having the leaf-blades serrulate throughout.

Known only from the type.

51.1. *Navia culcitaria* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 18, 30l–o. TYPE: Venezuela. Amazonas: Dept. Río Negro, sabanas abiertas sobre altiplanicie en la Serranía del Vinilla (ca. 20 km al SW de Mavaca) hacia el borde SW de la meseta, terrestre; muy frecuente entre las rocas, formando extensos cojines, 760 m alt., Lat. 2°20', Long. 65°22', 13 June 1981, O. Huber 6184 (holotype, US; isotype, VEN).

Herba pulvinos extensos formans (Huber), caulescens caule brevissimo. Folia plurima, ad 17 cm longa; laminis sublinearibus, vulgo 3 mm raro 5 mm latis, integris, margine albo-ciliatis, alibi glabris.

Inflorescentia sessilis, ovoidea, multiflora; bracteis involucrantibus foliaceis. Bracteae florigerae ellipticae, apiculatae, quam sepalis breviora. Sepala libera, anguste oblonga, obtusa, cucullata, 11 mm longa.

Leaf anatomy. Vascular bundles broadly covered by chlorenchyma adaxially and abaxially; water storage cells only adaxial, up to 4-stratose; subepidermal cells of both surfaces narrow, scarcely incrassate; substomatal pores nearly occluded, transversely elongate, halteriform, with walls strongly thickened.

In its leaf anatomy the species seems close to *Navia cardonae* and the above described *N. delascionis* both of which differ by their shorter more serrulate leaves.

Known only from the type.

51.2. *Navia piresii* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 18, 30f. TYPE: Brazil. Amazonas: Serra Aracá, 10 February

1975, J. M. Pires 15.014 (37) (holotype, US; isotype, IPEAN).

Caulescens; caule qui adest brevissimo. Folia ad 15 cm longa; vaginis brevibus, ovatis, atro-castaneis; laminis angustissime triangularibus, 5 mm latis, integris, marginibus albo-ciliatis, alibi glabris.

Inflorescentia sessilis, pauciflora; bracteis involucrantibus ellipticis, apiculatis, inflorescentiam aequantibus, tenuibus, siccis rubro-brunneis. Bracteae florigerae anguste ellipticae, sepala aequantes, membranaceae. Sepala libera, oblonga, obtusa, 10 mm longa.

Leaf anatomy. Vascular bundles broadly covered by chlorenchyma adaxially and abaxially; water storage cells adaxially up to 5-stratose, abaxially less inflated, indistinctly demarcated, ca. 3-stratose; subepidermal cells on both surfaces narrow, scarcely incrassate; substomatal pores broadly oval, with slight paired protrusions on each side at junctures of cells, with walls not incrassate; abaxially only obconical basal parts of scales seen.

In size and anatomy the leaf of the species seems close to the Colombian species, *Navia bicolor*, which belongs to a distinct group having connate sepals. The abaxial water storage tissue is not as prominent, being more like a pale, more enlarged abaxial zone of the chlorenchyma. Perhaps closest relationship is to the above described *N. crassicaulis*, which is distinguished by its broader leaves and generally more robust stature.

Known only from the type.

51.3. *Navia berryana* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 19, 30g–k. TYPE: Venezuela. Amazonas: Dept. Río Negro, on rocks along stream, on outcrops of quartzite in savannas and gallery forests near and north of Cerro Vinilla, ca. 30 km SSW from Ocamo, along streams tributary to the Río Orinoco, 440–600 m alt., Lat. 2°31'N, Long. 65°23'W, 1–2 March 1984, Steyermark, Berry & Delascio 130318-A (holotype, US; isotype, VEN).

Caulescens; caule erecto, 4 cm alto. Folia 20 cm longa; vaginis brevibus; laminis angustissime triangularibus, 3 mm latis, marginibus ciliatis alibi glabris, minutissime laxaque serrulatis, interioribus basi albis.

Inflorescentia terminalis, breviter scaposa; scapi bracteis foliaceis. Bracteae florigerae late rotundae, apice apiculatae incrassataeque. Sepala libera, 9 mm longa, lateralibus linearibus, apice apiculata incrassataeque.

Leaf anatomy. Vascular bundles covered by

chlorenchyma adaxially and abaxially; innermost adaxial water storage cells sporadically resiniferous; subepidermal cells with parts of walls nearest leaf surface thickened, resiniferous; substomatal pores nearly occluded, transversely elongate, halteriform; abaxial scales sparse, rudimentary.

In the combination of its leaf anatomy and geography, the new species may be most closely related to *Navia delascionis* described above. The latter differs by its longer more serrulate leaves.

Known only from the type.

52.1. *Navia filifera* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 20, 30p–u. TYPE: Venezuela. Amazonas: Dept. Río Negro, Camp III, Neblina and Massif, NW Plateau (Arm), 13.5 km ENE of Cerro de La Neblina Base Camp, 1,750–1,850 m alt., Lat. 0°54'N, Long. 66°04'W, 16–18 February 1984, Ronald Liesner 16025 (holotype, US; isotype, MO).

Caulescens; caule erecto, ca. 9 cm alto. Folia 12 cm longa; vaginis brevibus, atris; laminis anguste triangularibus, 6 mm latis, subtus et in marginibus trichomatibus filiformibus albis laxè vestitis, laxè serrulatis.

Inflorescentia terminalis, sessilis, subglobosa, 2 cm diametro, petalis exceptis trichomatibus filiformibus laxè vestita; bracteis involucrentibus subfoliaceis, inflorescentiam multo superantibus. Bracteae florigeræ ovatae, acutae, valde nervatae, sepala subaequantia. Sepala libera, 7 mm longa; posterioribus obtusis cucullatisque; petalis albis (Liesner); ovario supero.

Leaf anatomy. Vascular bundles adaxially maximally and abaxially minimally covered by chlorenchyma; water storage cells forming strongly distinct abaxial canals; adaxial cells paucistratose; adaxial subepidermal cells 1–3-stratose, resiniferous, outermost with cell walls nearest leaf surfaces thickened; substomatal pores not occluded, rounded; abaxial hairs uniseriate, long, from bulbous base.

The leaf cross-section and the uniseriate hairs suggest closest relationship of the new species to *Navia crispa*, *N. viridis*, *N. lanigera*, and *N. myriantha*, all of which fall under Subkey II because of their more pointed, non-cucullate sepals.

Known only from the type.

REVISED SECTION OF SUBKEY IV

9. Leaf-blades not narrowed toward base; stems simple.

- 9a. Posterior sepals 10 mm long, ½ connate; leaf-blades 1–2 mm wide. Cerro Sipapo 60. *N. ocellata*
 9a. Posterior sepals 15 mm long, over ¾ connate, leaf-blades 4 mm wide. Cerro Sipapo 60.1. *N. lactea*

60.1. *Navia lactea* L. B. Smith, Steyermark & Robinson in Steyermark et al., Acta Bot. Venez. 14(3): 14, fig. 5. 1984.

At the time of the original description, the species was noted as having separate sepals, but they were correctly illustrated as connate.

REVISED SECTION OF SUBKEY V

1. Leaf-blades 17–30(–35) mm wide; petals yellow; ovary partly or wholly inferior.
 1a. Stem very short; leaf-blades uniform, slightly contracted toward base, uniformly spinose-serrate. Bolívar, Guyana 68. *N. arida*
 1a. Stem over 17 cm long; leaf-blades dimorphic, the terminal ones 40 cm long, 35 mm wide, flexible, adapted to shade, entire except for minute spines toward base, the lower blades grading to narrowly triangular, 6 cm long, uniformly narrowly triangular. Amazonas 68.1. *N. igneosicola*

68.1. *Navia igneosicola* L. B. Smith, Steyermark & Robinson, sp. nov. Figures 23, 31o–t. TYPE: Venezuela. Amazonas: Dept. Atures, area de selva y lajas igneas á lo largo del Río Coromoto, á Tobogán de la Selva, 35 km sureste de Puerto Ayacucho, 150 m alt., Lat. 5°22'N, Long. 67°33'W, 14 Mayo 1980, Julian A. Steyermark, Gerrit Davidse & Francisco Guanchez 122478 (holotype, US; isotypes, NY, VEN).

Caulescens; caule curvato, ultra 17 cm longa. Foliolorum vaginae parvae, inconspicuae; laminis dimorphis, eis terminalibus linearibus, apice attenuatis, ad basin versus paulo contractis et spinoso-serrulatis, 40 cm longis, 35 mm latis, flexibilibus et umbras amantibus, eis inferioribus mutatis in anguste triangularibus, ad basin versus haud contractis, omnino spinoso-serrulatis, 6 cm longis.

Inflorescentia centralis, sessilis, pauciflora; bracteis exterioribus ellipticis, tenuibus, foliaceo laminatis. Bracteae florigeræ angustissime triangulares, 27 mm longae, sepalis superatae, integrae, membranaceae, albo-lepidotae. Sepala libera angustissime triangularia, ad 45 mm longa, tenuia; petalis aurantiacis (Steyermark); ovario fere vel omnino infero.

Leaf anatomy. Vascular bundles lacking a cover of chlorenchyma on all adaxial surfaces

and most abaxial surfaces, largest bundles with fiber sheaths extending nearly or completely to the epidermis adaxially and abaxially; water storage cells with only 2–3 layers; subepidermal cells not thickened on either surface; substomatal pores not occluded, rounded or oval; abaxial scales rounded, peltate, with cells distinct, subisodiametrical, irregularly disposed, peripheral cells smaller and more tenuous.

Navia igneosicola is evidently closely related to *N. arida*, showing the same type of leaf-section, substomatal pores, and distinctive scales on the leaves.

11.1. **BREWCARIA** L. B. Smith, Steyermark & Robinson in Steyermark et al., Acta Bot. Venez. 14(3): 10. 1984.

Plants with leaves fasciculate-rosulate, rigid, spinose-serrate, in cross-section with vascular bundles not covered with chlorenchyma adaxially, with chlorenchyma continuous and unusually dense abaxially, substomatal pores nearly occluded; inflorescence erect, simple, densely spicate; flowers sessile, spreading; sepals imbricate, ecarinate; petals regular, appendaged with 2 horizontally attached scales; stamens equal; ovary partly inferior, style branches narrowly oblong; seeds exappendiculate or very narrowly winged.

The genus is known only from central Amazonas in Venezuela. Closest relationship is evidently to *Navia*, from which it differs by its simple, densely spicate inflorescence and its appendaged petals. The appendages differ from those in the more distantly related *Steyerbro-melia* by being transversely inserted.

1. Plant 2.5–3 m high; leaves more than 1 m long; blades lustrous beneath and sparsely lepidote, 25 mm wide; inflorescence 70 cm long
..... 1. *B. duidensis*

1. Plant not over 0.6 m high; leaves not over 0.5 m long; blades densely appressed lepidote beneath, 15 mm wide; inflorescence 16 cm long
..... 2. *B. marahuacae*

1. *Brewcaria duidensis* L. B. Smith, Steyermark & Robinson in Steyermark et al., Acta Bot. Venez. 14(3): 10, figs. 1a–j, 6a–e, photo 2. 1984.

2. ***Brewcaria marahuacae*** L. B. Smith, Steyermark & Robinson, sp. nov. Figures 24, 31u–y. TYPE: Venezuela. Amazonas: Dept. Ata-

bapo, Cerro Marahuaca–Atuhua–Shiho, cumbre, parte aislada al Sur-Oeste del Cerro, vegetacion no arbolada en terreno pendiente terrestre, common, 2,480 m alt., Lat. 3°30'N, Long. 65°20'W, 9–10 Feb. 1982, J. A. Steyermark, M. Guariglia, N. Holmgren, J. Luteyn & Scott Mori 126328 (holotype, US; isotypes, NY, VEN). PARATYPES: Dept. Atabapo: Cerro Marahuaca–Huha, 31 Jan. 1982, Steyermark, Guariglia, Holmgren, Luteyn & Mori 125909 (NY, US, VEN). Plant over 0.6 m high. Cerro Marahuaca, 10–12 Oct. 1983, Steyermark 129519 (NY, US, VEN). Stem varnished as well as young inflorescence. Cerro Marahuaca, March 1984, *Ostos in Tamayo* 6022 (VEN). Petals elliptic, cucullate, bearing 2 truncate scales.

Acaulis florifera usque 0.5 m alta. Folia multa, supremis usque 0.5 m longis; vaginis suborbicularibus, ca. 2 cm latis, subtus lepidotis; laminis angustissime triangularibus, basi 15 mm latis, planis, rigidis, spinis sursum curvatis 1 mm longis laxe serratis, supra dissite lepidotis, subtus squamis adpressis cinereis dense vestitis.

Scapus erectus, 13 mm diametro; scapi bracteis erectis, inferioribus foliaceis, dense imbricatis, superioribus ovatis, acuminatis, internodia superantibus sedscapum haud omnino occultantibus. Inflorescencia spica densa, multiflora, 16 cm longa. Bractee floriferae late ovatae, acuminatae, sepala subaequantur; floribus sessilibus, patentibus. Sepala ovata, obtusa, fructificantia 10 mm longa, posteriora obtuse carinata, cucullata. Ovarium paulo inferum. Semina angustissime alata.

Leaf anatomy. Scarcely distinct from *Brewcaria duidensis*, but with less enlarged chlorenchyma cells between the vascular strands, and with raphid-bearing idioblasts between most of the strands.

The cited differences in the leaf anatomy are based on a limited sample and should be used with caution.

TILLANDSIOIDEAE

14. **TILLANDSIA** L. Sp. Pl. 286. 1753.

REVISED SECTION OF SUBKEY IX

46a. Plant flowering 1–2 m high; primary bracts lanceolate, acute. Colombia, Ecuador, Peru
..... 9. *T. pyramidata*

46a. Plant flowering ca. 0.6 m high; lower primary bracts linear-laminate. Venezuela
..... 9.1. *T. abysmophila*

9.1. ***Tillandsia abysmophila*** L. B. Smith & Steyermark, sp. nov. Figures 25, 32a–d. TYPE:



FIGURES 25, 26.—25. *Tillandsia abyssophila* Smith & Steyermark.—26. *Guzmania terrestris* Smith & Steyermark.

Venezuela. Amazonas: Dept. Río Negro, Cerro Aratitoyope, epifita en selva alta, a lo largo de un riachuelo afluente a Río Manipitare, 990–1,670 m alt., Lat. 2°10'N, *Julian A. Steyermark, Paul Berry & Francisco Delascio 130135* (holotype, US; isotypes, NY, VEN).

Verisimiliter acaulis, florifera ca. 6 dm alta. Folia ca. 5 dm longa, subtus squamis adpressis cinereis in centro atris dense vestita; vaginis ellipticis, 10 cm longis, supra lepidotis; laminis ligulatis, acuminatis, 3 cm latis, supra glabris.

Scapus erectus, gracilis; scapi bracteis subfoliaceis, dense imbricatis. Inflorescentia laxa bipinnatim paniculata, 26 cm longa, glabra; bracteis primariis late ovatis, quam spicis brevioribus, inferioribus lineari-laminatis; spicis divergentibus, sessilibus, lineari-lanceolatis, 8.5 cm longis, 1.5 cm latis, complanatis. Bractee florigerae ovatae, acutae, 25 mm longae, carinatae, rigidae, laevigatae. Sepala linearia, acuta, 22 mm longa, bracteis florigeris inclusa, posteriora carinata, alte conata.

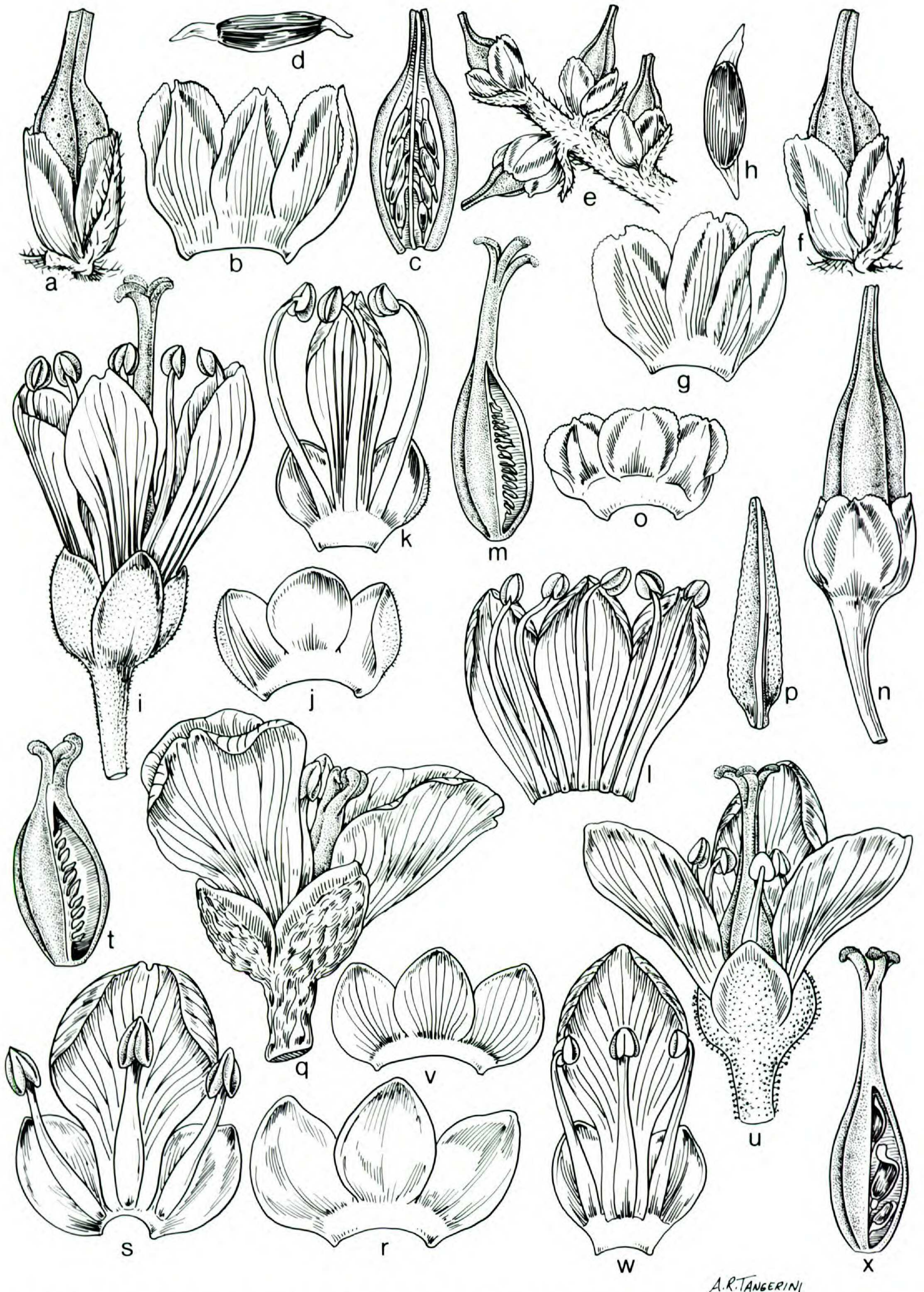
16. **GUZMANIA** Ruiz & Pavon, Fl. Peruv. Chil. 3: 37, pl. 266. 1802.

REVISED SECTION OF KEY

- 36a. Floral bracts 15 mm long, their margins broad, pale, strongly crisped; sepals 31 mm long, similar to the floral bracts. Colombia 28. *G. radiata*
 36a. Floral bracts 10 mm long, concolorous, their margins scarcely if at all crisped. Venezuela 28.1. *G. terrestris*

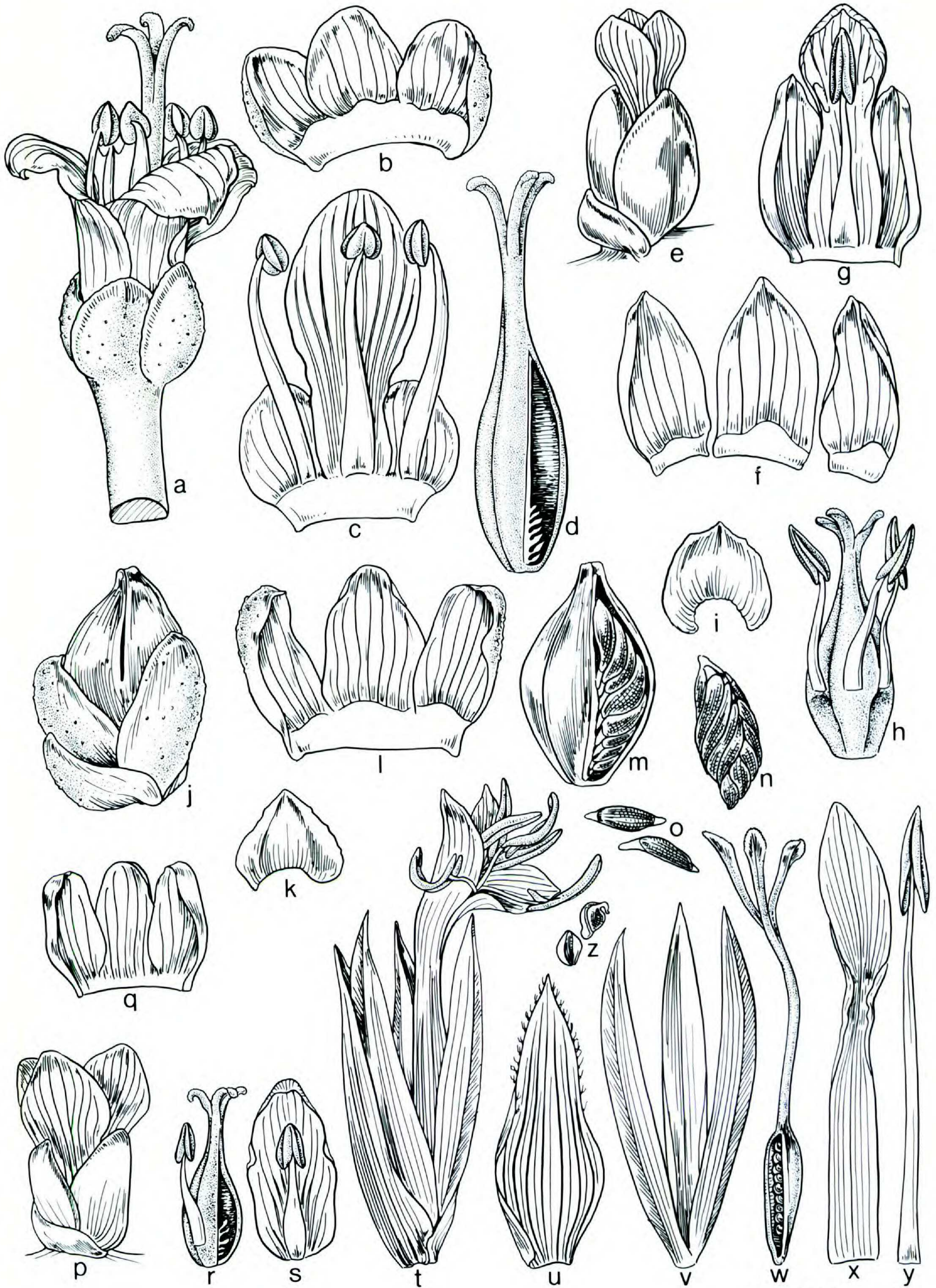
28.1. ***Guzmania terrestris*** L. B. Smith & Steyermark sp. nov. Figures 26, 32e–l. TYPE: Venezuela. Amazonas: Dept. Atabapo, Cerro Marahuaca, Cumbre, parte central de la Meseta Sur-Este, al lado de una grieta, a lo largo de la Quebrada Yekuana, afluente del Río Negro, 2,560 m alt., Lat. 3°40'30"N, Long. 65°26'20"O, 10–12 Oct. 1983, *Julian A. Steyermark 129596* (holotype, US; isotypes, NY, VEN). PARATYPE: Cerro Marahuaca, 13–14 Oct., *Steyermark 129526* (NY, US, VEN).

Verisimiliter acaulis, florifera ultra 47 cm alta. Folia 35 cm longa, utrinque squamis minimis dissite lepi-



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FIGURE 27.—a. *Lindmania sessilis* flower.—b. Sepals.—c. Fruit.—d. Seed.—e. *Lindmania saxicola* branch of inflorescence.—f. Flower.—g. Sepals.—h. Seed.—i. *Lindmania aurea* flower.—j. Sepals.—k. Petals, stamens and sepals.—l. Petals.—m. Pistil.—n. *Lindmania imitans* flower.—o. Sepals.—p. Seed.—q. *Lindmania riparia* flower.—r. Sepals.—s. Petals and stamens.—t. Pistil.—u. *Lindmania piresii* flower.—v. Sepals.—w. Petal and stamens.—x. Pistil.



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FIGURE 28.—a. *Lindmania huberi* flower.—b. Sepals.—c. Petals and stamens.—d. Pistil.—e. *Steyerbromelia diffusa* flower.—f. Sepals.—g. Appendaged petals and stamens.—h. Pistil and stamens.—i. Bract.—j. *Navia plowmanii* flower.—k. Bract.—l. Sepals.—m. Ovary.—n. Seed cluster.—o. Seeds.—p. *Navia thomasi* flower.—q. Sepals.—r. Pistil and stamens.—s. Petal and stamen.—t. *Navia polyglomerata* flower.—u. Bract.—v. Sepals.—w. Pistil.—x. Petal.—y. Stamen.—z. Seeds.

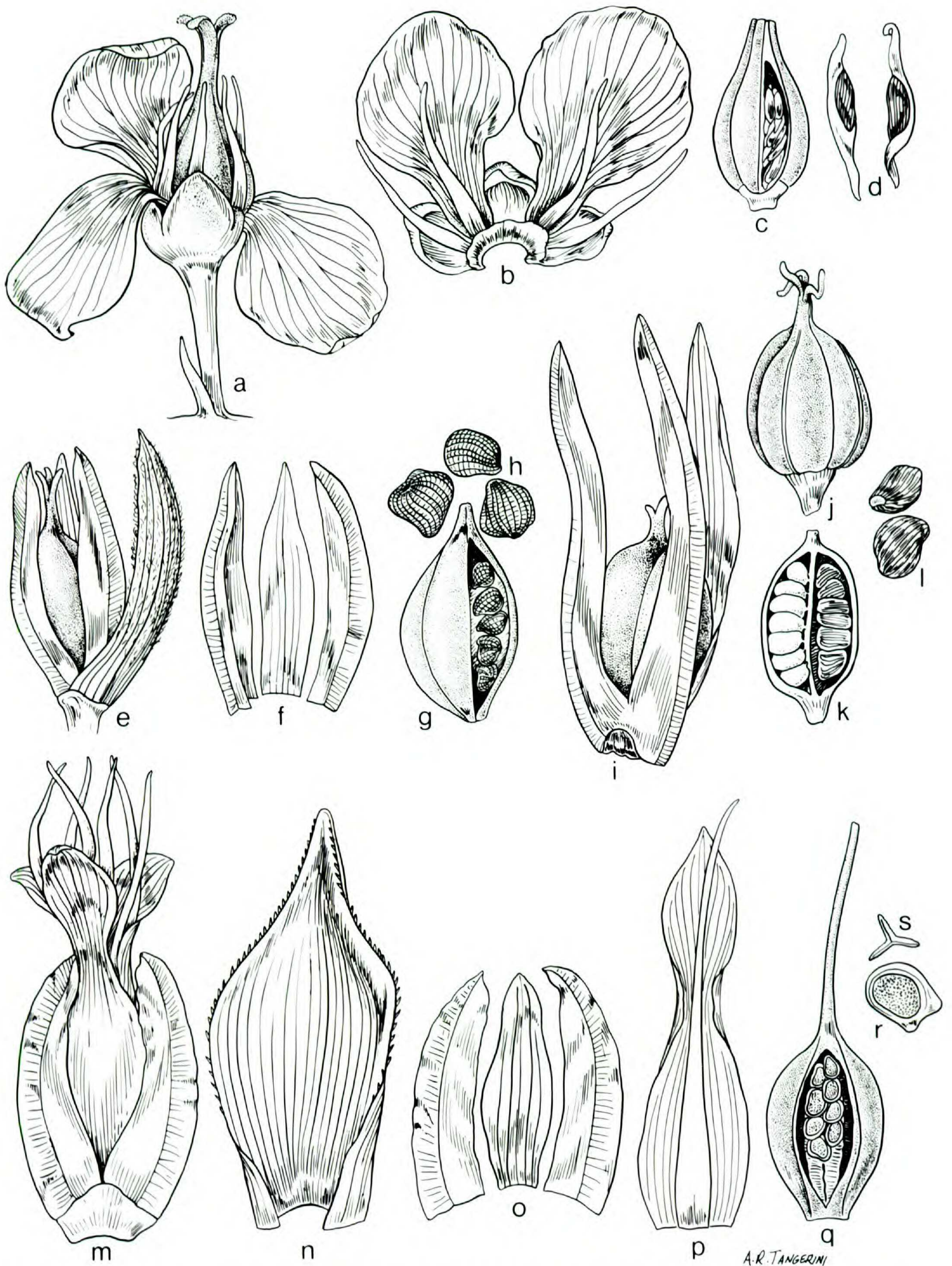
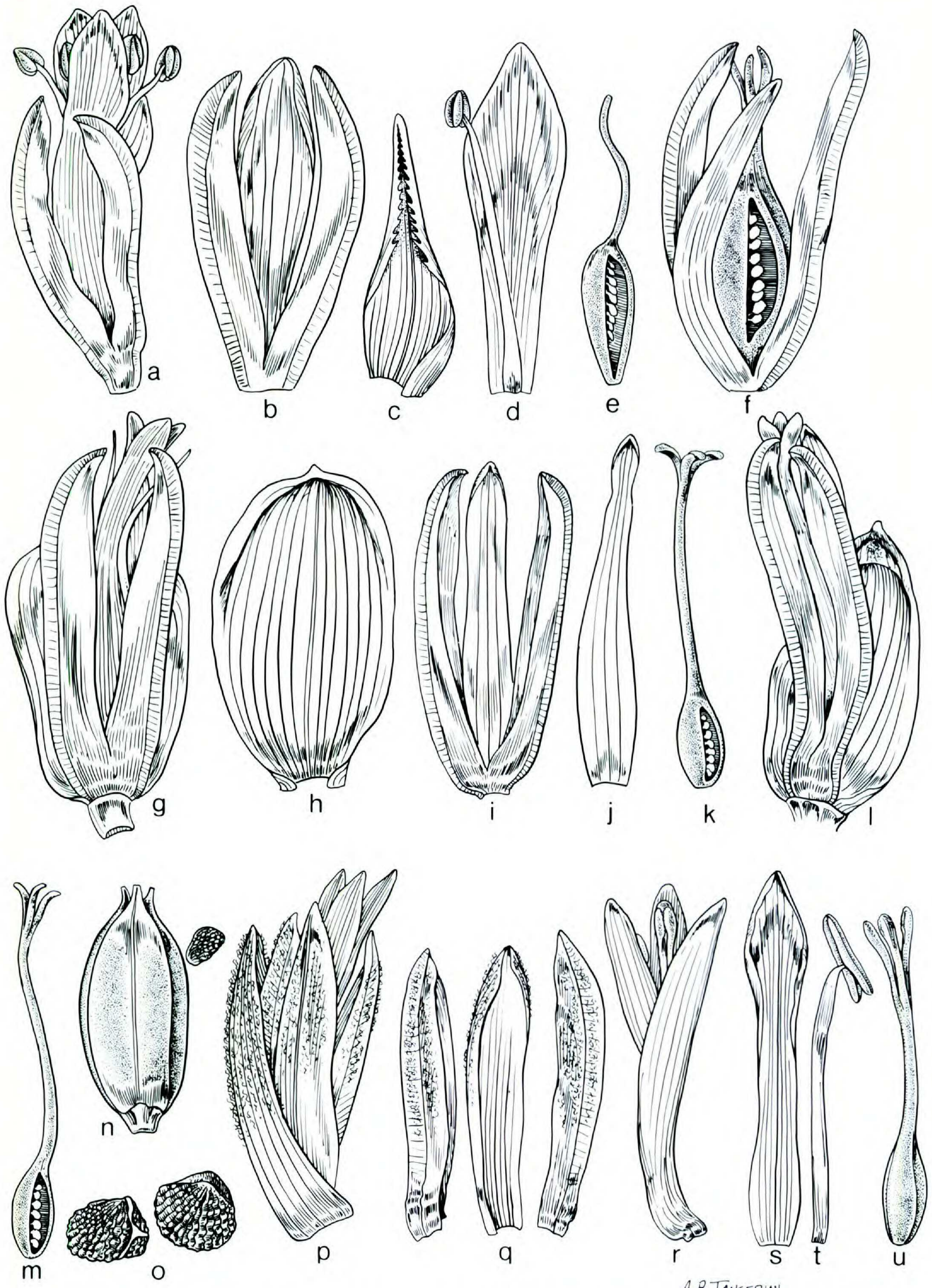


FIGURE 29.—a. *Lindmania terramarae* flower and bract.—b. Sepals and petals.—c. Fruit and seeds.—d. Seeds.—e. *Navia huberiana* flower and bract.—f. Sepals.—g. Fruit.—h. Seeds. i. *Navia pedemontana* sepals and fruit.—j. Fruit.—k. Fruit showing seeds.—l. Seeds.—m. *Navia crassicaulis* flower.—n. Bract.—o. Sepals.—p. Petal and filament.—q. Fruit showing seeds.—r. Seed.—s. Section of ovary (orange part).



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FIGURE 30.—a. *Navia linearis* flower.—b. Sepals.—c. Bract.—d. Petal and stamen.—e. Pistil.—f. *Navia piresii* sepals and pistil.—g. *Navia berryana* flower and bract.—h. Bract.—i. Sepals.—j. Petal.—k. Pistil.—l. *Navia culcitaria* flower and bract.—m. Pistil.—n. Fruit and seed.—o. Seeds.—p. *Navia filifera* flower and bract.—q. Sepals.—r. Petals.—s. Petal.—t. Stamen.—u. Pistil.

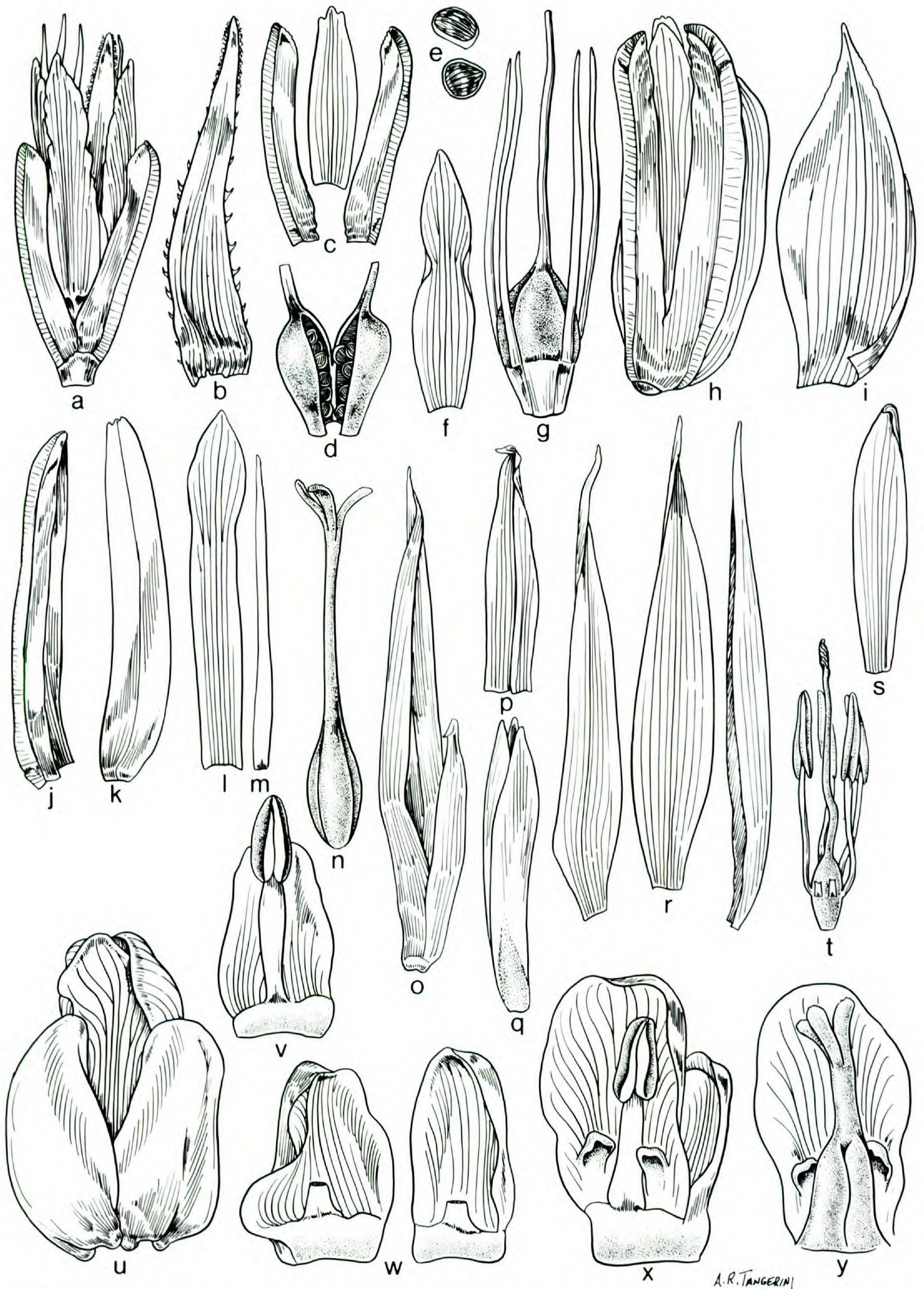


FIGURE 31.—a. *Navia liesneri* flower.—b. Bract.—c. Sepals.—d. Ovary and seeds.—e. Seeds.—f. Petal.—g. Pistil and filaments.—h. *Navia delascionis* sepals and bract.—i. Bract.—j. Posterior sepal.—k. Anterior sepal.—l. Petal.—m. Filament.—n. Pistil.—o. *Navia igneosicola* flower and bract.—p. Bract.—q. Flower.—r. Sepals.—s. Petal.—t. Pistil and stamens.—u. *Brewcaria marahuacae* flower.—v. Sepal and stamen.—w. Sepals.—x. Sepal, petal and stamen.—y. Petal and pistil.

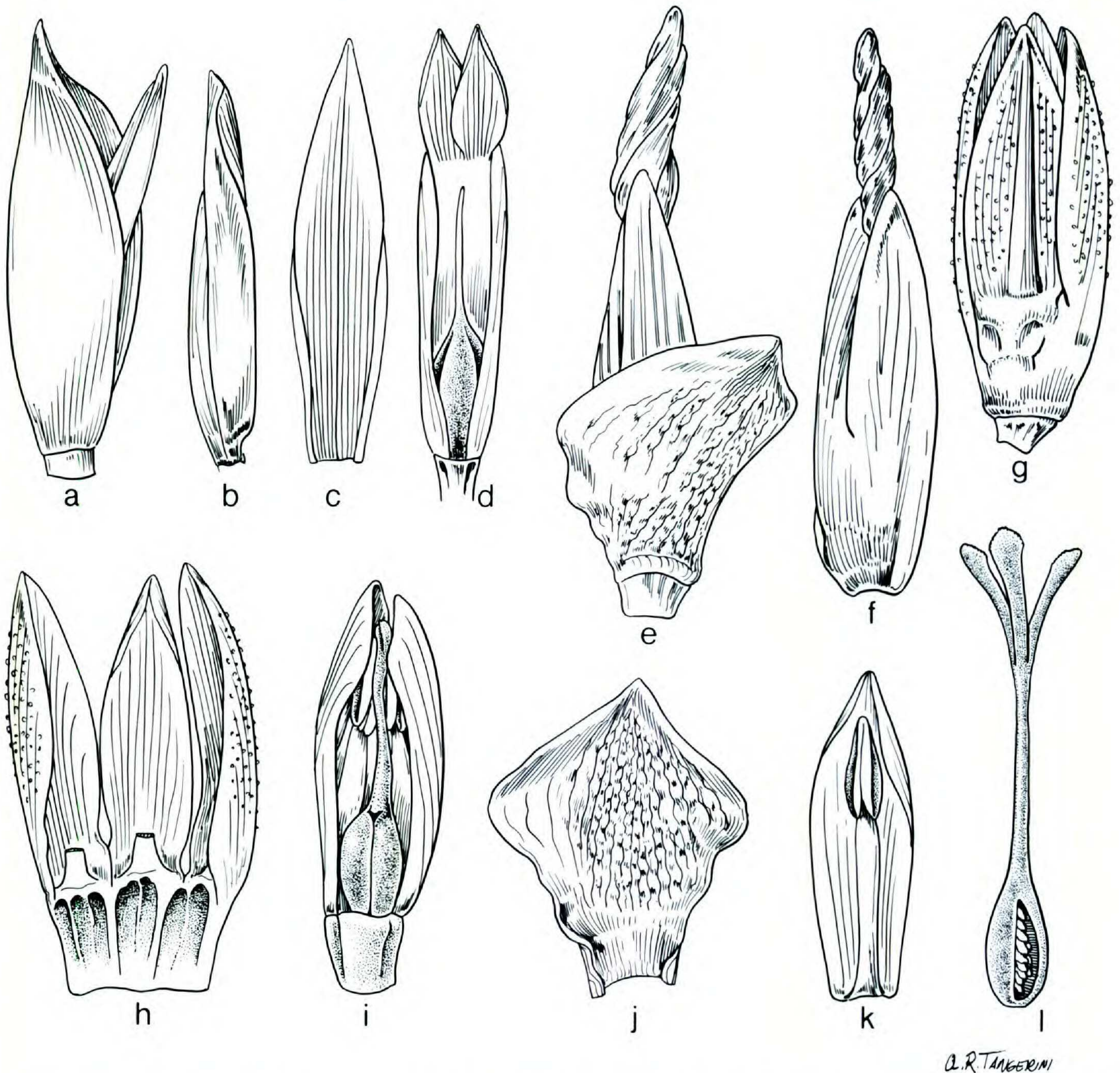


FIGURE 32.—a. *Tillandsia abyssophila* bract and flower.—b. Sepals closed.—c. Anterior sepal.—d. Posterior sepals.—e. *Guzmania terrestris* flower and bract.—f. Flower.—g. Sepals.—h. Sepals opened.—i. Petals, stamens and pistil.—j. Bract.—k. Petal and stamen.—l. Pistil and ovules.

dota; vaginis brevibus amplis; laminis anguste oblongis, 4 cm latis, apice attenuatis.

Scapus cylindricus, obscure lepidotus; scapi bracteis erectis, imbricatis, late ovatis, attenuatis. Inflorescentia laxe bipinnatim paniculata, 38 cm longa, dissite lepidota, mox glabra; bracteis primariis ovatis, infimis ramos superantibus; ramis divergentibus, ca. 10-floris. Bractee florigerae late obovatae vel suborbiculares, 1 cm longae, apice apiculatae cucullataeque, rubrae (Steyermark), tenues; floribus sessilibus, divergentibus. Sepala 17 mm longa, ad 3 mm connata lobis liberis ellipticis, obtusis, forte nervatis; petalis luteis (Steyermark), laminis ellipticis, 7 mm longis; staminibus inclusis; antheris 4 mm longis.

(1892) 281–424, pl. 62–80; (1894) 425–634, pl. 81–114.

ROBINSON, H. 1969. A monograph on foliar anatomy of the genera *Connellia*, *Cottendorfia* and *Navia* (Bromeliaceae). *Smithsonian Contr. Bot.* 2: 1–41.

SMITH, L. B. 1967. Bromeliaceae of the Guayana Highland. *Mem. New York Bot. Gard.* 14(3): 15–68.

——— & R. J. DOWNS. 1974. Pitcairnioideae (Bromeliaceae). *Flora Neotropica* 14: 1–660.

——— & ———. 1977. Tillandsioideae (Bromeliaceae). *Flora Neotropica* 14(2): 661–1492.

STEYERMARK, J. A., B. MAGUIRE & COLABORADORES. 1984. Nuevos taxa de la Guayana Venezolana. *Acta Bot. Venez.* 14(3): 5–52.

LITERATURE CITED

MEZ, C. 1894. Bromeliaceae. In C. F. P. Martius, *Flora brasiliensis* 3(3): (1891) 173–280, pl. 51–61;